

THE APPLICATION OF MICROECONOMIC THEORY  
TO  
MANPOWER MANAGEMENT

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THE APPLICATION OF MICROECONOMIC THEORY  
TO  
MANPOWER MANAGEMENT

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## SUMMARY

The current trend of a declining budget for defense emphasizes the need for an efficient resource allocation process. In many areas, however, the effective utilization of available funds is lacking. An analysis of the procedures practiced in the Air Force Manpower Management Program verifies this statement. This paper reviews the manpower management field, and suggests revisions to current policy in an attempt to introduce economy into the expenditure of the manpower resource dollar.

Although the Manpower Management Program functions on three distinct levels of operation, the Base Level has been selected for analysis for two reasons. First, personal involvement in a manpower standard's study provided in-depth knowledge of the practices and problems of the field. Second, and more importantly, the Base Level is the plateau of operation where the allocation of manpower authorizations actually occurs. If an effective proposal is developed, the process begins at this point.

Presentation of the Base Stock Funds accounting work center study provides an example of the current standard setting procedure. Analysis shows several problem areas in the accuracy and applicability of the resultant manpower determinant. First, the manning standard is not based on the budgeted resource. The number of authorizations assigned to the functions is not considered.

Second, a constant relationship of man-hour input to work unit output is hypothesized. This assumption results in the assignment of an equivalent output expectation for each worker, regardless of grade level or experience. Third, the erroneous assumption of constant output results in a workload backlog. Fourth, the manpower standard is the result of

token supervisory participation. The person most familiar with the work center performs a passive role in the determination process. Finally, the procedures currently employed are extremely expensive. Study team, clerical, and administrative costs are high when the number of manpower spaces allocated by the standard is considered.

In an attempt to resolve these problem areas, Microeconomics, more specifically the marginal concepts, is viewed with emphasis on current defense utilization by using an example of weapon system procurement with a fixed budget. Given a level of effectiveness which must be maintained, marginal analysis allows the quantification of the trade-offs within the realm of weapon system combinations, cognizant of the monetary constraints imposed. Through an iterative process, the decision can be made as to the particular force levels which maximize overall effectiveness. The successful analysis of a related resource expenditure problem lends credence to the theory that Microeconomics may be useful in solving the stated manpower problems.

The Air Force Clinical Laboratory Automation System (AFCLAS) provides the example of the concurrent utilization of economic and non-dollar evaluations in a manpower related decision. Although marginal concepts are not used in the system's analysis, the evaluation process shows a successful combination of Manpower Management and economics to more effectively reach a decision.

A more effective means of allocating the manpower resource is needed. My intent is to develop a manpower standard setting process which will utilize the marginal concepts of microeconomics, and fulfill that need.



The introduction of marginal analysis to the manpower process results in an economical and realistic manning procedure. The marginal approach developed addresses each of the problem areas. The budget allocation is an integral part of the standard's determination. Output is recognized as a variable based on grade and experience. The output capability of the work center is considered by workload assigned in excess of capability being deferred or reassigned. Significant work center participation is required in the initial stages of data collection. The marginal manpower approach is an inexpensive method of standard's development. One manpower officer is required for the study, with a minimal expenditure of clerical and administrative time.

Limitations were also found to the marginal approach. The revised process is extremely sensitive due to the data required. Specific trends must be followed or the marginal approach is ineffective. This sensitivity limits the procedure to "paper-work" type work centers. Functions such as maintenance, headquarters, or planning departments would not be acceptable areas of application. In addition, due to the relative ease in utilizing the marginal manning approach, this process may be incorrectly applied to a work center, simply to arrive at a manpower standard quickly.

In conclusion, I feel that the application of microeconomic theory to manpower management results in a manpower standard setting process which complements the current manpower discipline. It does possess inherent limitations, but the marginal manpower approach is a process which is economical, realistic, and an effective method in the allocation of the manpower resource.

## CHAPTER I

### INTRODUCTION

The Application of Microeconomic Theory to Manpower Management is significant in two specifics. First, from a personal standpoint, this topic involves academic disciplines which are of importance to me: Industrial Engineering, in which I have done extensive study; Manpower Management, the field to which I am currently assigned; and Economics, in which I intend to conduct advanced graduate work. Secondly, this topic concerns a "real-world" problem. The economic crisis of this nation dictates frugality in defense spending; thus analysis of defense manpower allocations are of crucial importance. Not only must capability be maintained at levels sufficient to meet any situation, this same capability must be maintained with decreased capital expenditures. It is, therefore, imperative that the resources devoted to defense, in this instance to Air Force manpower, be utilized in the most efficient manner.

It is the intent of this paper to explore the feasibility and value of the application of microeconomic concepts, in particular, marginal concepts, to Air Force manpower management decisions.<sup>1</sup> The desired result is the development of improved analytical methods in the allocation of human resources and a dwindling dollar supply.

This paper commences with an explanation showing the topic is of sufficient value to warrant the effort of a thesis project. Included is a detailed analysis of the defense manpower dollar and the current trends in defense spending. There is a need for immediate improvement of ana-

lytical capability in defense expenditures. If manpower decisions are to be based on budgetary constraints, a more economics-oriented analysis must be conducted. A review of the concepts and practices of the manpower management discipline is followed by a discussion of manpower management in terms of military personnel. In the next portion, microeconomics, specifically the marginal concepts, is reviewed, textbook fashion, with an eye to defense applications. The interaction of microeconomics and the defense budget in the perspective of weapons acquisition and deployment is presented as an example of a present day application of the marginal concepts.

The Air Force Clinical Laboratory Automation System (AFCLAS) provides an example of the concurrent application of economics and manpower considerations in a problem of equipment procurement. Besides conducting an economic analysis of a proposed acquisition, the man-machine interface, and resultant problems of organizational behavior are considered. The evaluation plan determining the feasibility of AFCLAS procurement leads to the hypothesis of this paper. If economics is valuable in evaluating the acquisition decision of a manpower related system, these concepts may then be utilized in the evaluation of manpower management problems.

As a result of the research in manpower management and microeconomics, and in consideration of the specific procedures employed in the AFCLAS evaluation plan, significant modifications of present manpower processes are proposed in the concluding section. The application of microeconomic concepts to the manpower determination process results in an extensive revision of the current procedures. Finally, the future course of impending manpower management decisions is presented.

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## CHAPTER II

### THE MANPOWER DOLLAR

During the past ten years, the United States has been moving toward a more costly defense structure. The costs of supporting each unit of military force have grown steadily. Two trends are generally attributed to be the cause of this increase: the increased cost of military equipment, and the wage increases resulting in greater costs of manpower.<sup>1</sup> While the analysis of the facet of equipment expenditures is beyond the scope of this paper, the rising cost of manpower is of fundamental concern herein.

A frequently suggested "quick" remedy for the high cost of personnel is adoption of more efficient manpower management; the solution is much more complex. It is of cardinal importance that the individuals involved in manpower decisions be supplied information resulting from more thorough and exacting analytical processes. The ultimate goal of this research paper is to aid in the optimum allocation of human resources within the applied economic parameters.

It is generally understood that the defense dollar is decreasing in quantity and in purchasing power.<sup>2</sup> Present economic inflation and increased congressional scrutiny has created the demand for austerity in Pentagon spending.<sup>3</sup> Manpower levels must ultimately be affected by the pressure to reduce expenditures. Representative George H. Mahon, Chairman of the House Appropriations Committee in 1973, forecast this pressure, in June of that year, when he cited the defense manpower budget as

the primary target of Congressional review.<sup>4</sup>

As previously suggested, the past decade of defense spending has witnessed a substantial increase in manpower costs. Figures 1 and 2 depict recent trends in Defense Manpower Spending and Air Force Manpower Spending respectively. The information presented is based on the amount expended for uniformed, active duty and active reserve forces.<sup>5</sup>

Figure 1 reflects the effect of the Southeast Asian conflict on the defense budget, and the significant problem of surplus personnel it created after the Paris Peace Treaty was signed. The expenditures of 1966 were incurred during the force build-up prior to peak military activity in the area. However, with the disengagement of combat forces in early 1972, thousands of individuals were released from active duty, thereby causing a significant reduction in manpower costs.<sup>6</sup> Two opposing influences warrant attention at this point. First, the reduction in manpower costs is also the result of both voluntary and involuntary early separations of individuals from service during 1973 and 1974. Secondly, while total spending decreased, individual salaries were raised substantially during 1974 and, at this writing, are expected to increase in 1975.

Figure 2 illustrates a significant increase in Air Force manpower expenditures during the same time frame. However, contrary to the information of the previous graph, manpower spending did not fluctuate radically as a result of the Southeast Asian conflict. Instead, increases in salaries and the conversion of the military to an all-volunteer force created the need for an increased manpower budget. Of course, the Air Force did not rely on conscription prior to the abolition of the draft.

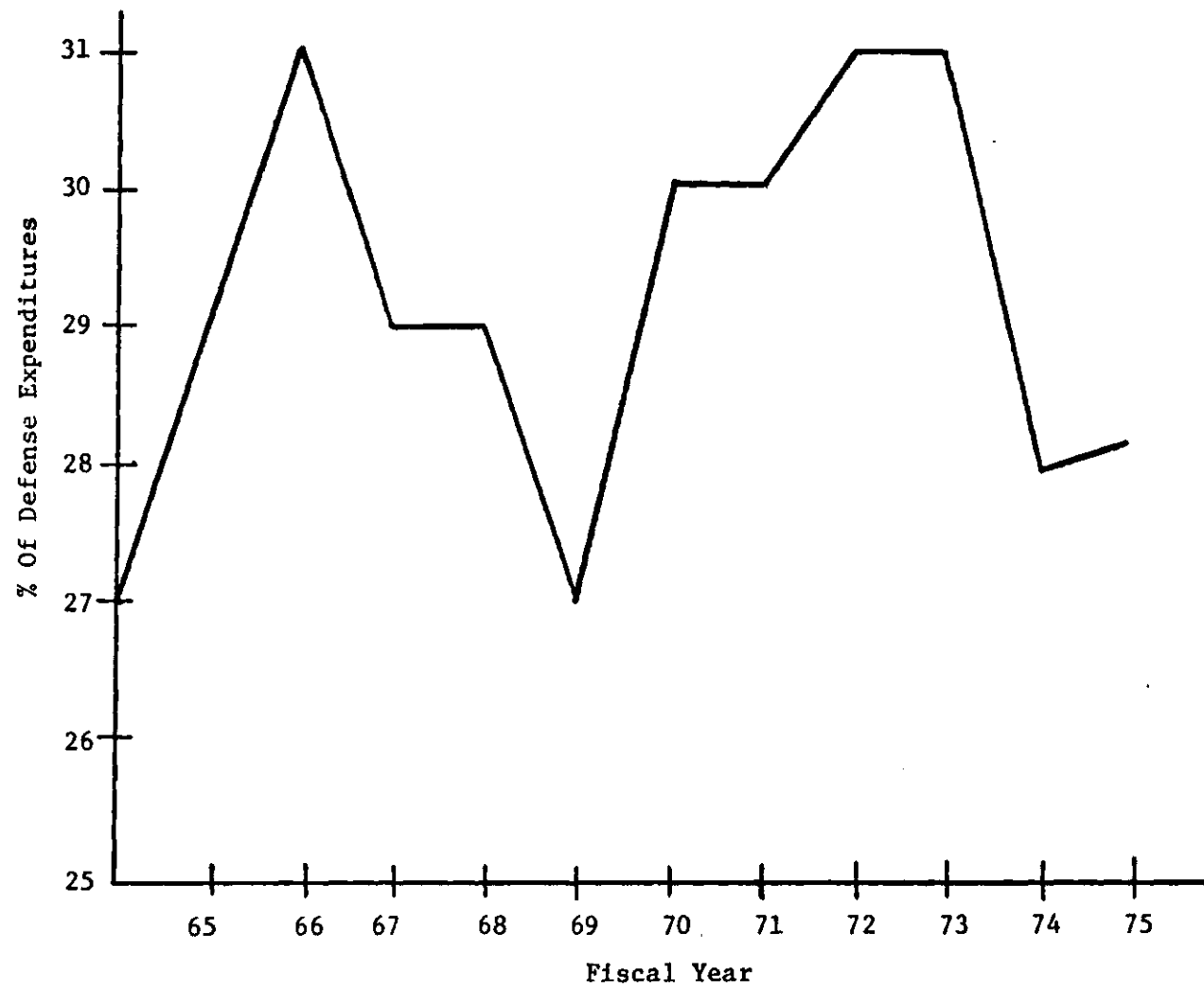


Figure 1. Defense Expenditures for Manpower

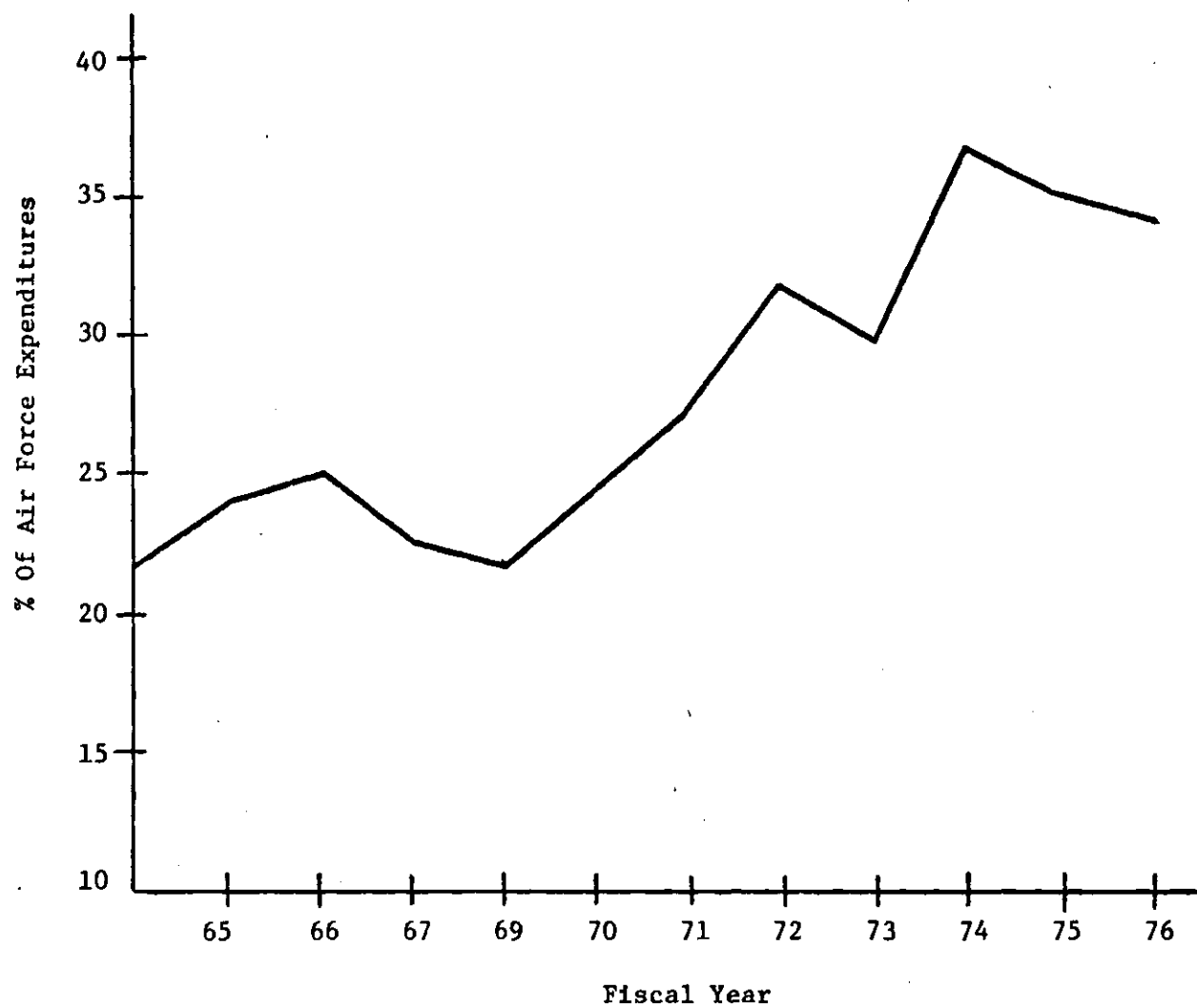


Figure 2. Air Force Expenditures for Manpower



However, individuals who once enlisted in the Air Force to avoid the draft and the Army, now enlist due to the higher pay rates and the security of at least four years of employment.<sup>7</sup> Finally, the projected 1975 budget shows a further decrease in manpower money. Once again this is due to the early separation program initiated to trim the Air Force of its excess officer corps.

As presented, this information may seem unsupportive of the stated problems of manpower finance. However, had federal employee salaries, retired employee benefits, military fringe benefits, and the multitude of other expenditures listed as personnel costs been included, substantially different charts would have resulted.<sup>8</sup> For example, in 1965, 43 per cent of the total Department of Defense budget was allocated to personnel expenditures. In 1975, manpower requests accounted for 55 per cent of the Defense budget.<sup>9</sup> The necessity for reductions in spending, leading to proposed reductions in force is clear. Presently, 18 per cent of the work force is employed by the United States government. It is estimated that if the present trend continues, by the year 2000, 50 per cent of the workers in this country will be federal employees.<sup>10</sup>

Government economists at all levels must arrest the current spiral of manpower expenditures. In particular, defense planners must approach their task with criteria modified to reflect the constraints of the current national and world situation.

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## CHAPTER III

### MANPOWER MANAGEMENT

"Manpower is the basic resource.  
It is the indispensable means  
of converting other resources  
to mankind's use and benefit".<sup>1</sup>  
John F. Kennedy

Human beings are, literally, the lifeblood of a nation. The strength, skills, attitudes and behavior of the citizenry reflect the concepts upon which a country is established. Whether the focus of study is an emerging nation aspiring to greatness, or a world power striving to maintain its position, the development and employment of its human resources must be husbanded as prudently as the utilization of any other natural resource.<sup>2</sup>

Raw talent is as useless as unrefined ore. Talent achieves a value only by being developed; thereby creating a usable skill.<sup>3</sup> The most wasteful management of human resources occurs when societies neglect to utilize the potentialities of the populace.<sup>4</sup> Any entity seeking a stable existence should attempt to increase the knowledge, skills, and abilities of its people. It must endeavor to develop the human resource to the fullest capacity and utilize it to realize its goals. Investment in the development of manpower must be no less in substance than in the improvement of its material wealth, in an attempt to seek the most prudent expenditure of both assets.

Human resources must be measured and evaluated, requirements cal-

culated, and a realistic program devised for the development and utilization of manpower. Yet, a policy must be maintained which will balance the needs of the organization in accordance with the inherent rights of the individual. To facilitate economic growth and security, attention should be directed toward the individuals comprising the nation, society or organization. If the existence of its members is enhanced, it follows that the entity's prospects for the future improve.<sup>5</sup> To this end, the concept of manpower management becomes one of basic importance.

Operationally defined, manpower management is the procedure established by experience, by trial and error, and from research, to obtain predetermined goals. It represents the means by which an organization seeks to gain stated ends with respect to economic activity through the use of human resources.<sup>6</sup> It has been found that manpower management is as essential in a managed economy as in one that emphasizes free enterprise.<sup>7</sup> However, the specific policies and programs of the manpower management field do significantly differ reflecting the various political and social ideologies. While management must plan, direct and coordinate the application of manpower regardless of the philosophy of the state, when the individual is the basic consideration, the results prove most beneficial.

The need for comprehensive planning and co-ordination increases with the complexity and size of a society. While manpower management may be relatively simple in a primitive group; it must be more highly developed in a modern industrialized society. Evidence of this fact is exhibited by the increased interests of many industries in the United States in manpower management theories. Norman Matte, President of

Kierman and Company, a consulting firm, cites the increasing cost of manpower as the major force in the establishment of manpower management functions. Consideration of manpower has led the executives of Rockwell International to establish an environment in which line management is expected to learn the needs and goals of their charges and plan the work accordingly.<sup>8</sup>

Recently, attitudes of management have necessarily been altered in the face of the economic pressures of the times. In the past, resources were generally felt to be limitless as long as there were ample funds to purchase them. However, the present awareness of resource limitations coupled with increased demands on economic capacity, has forced frugality in the personnel function. As increased allocations become necessary to purchase the raw materials, other areas of the organization experience a decrease in their allotments. This calls for more prudent use of, among other things, their manpower. Significant emphasis on the manpower management discipline has resulted.

#### Manpower Management in the Department of the Air Force

The manpower management function of the Department of the Air Force is operational on three distinct plateaus: the Pentagon level, the command level, and the field level.<sup>9</sup> Those in the profession of defense, Pentagon level, are confronted with manpower problems influenced by external forces such as the international climate, national economic conditions and societal limits on military strength.<sup>10</sup> The implementation of manpower decisions is of minimal concern to those who determine policy. However, a broad understanding of manpower management as it relates to

defense becomes necessary background information to formulate policy.<sup>11</sup>

At the command level, the definition of manpower management becomes: the translation of Pentagon directives into actual manning allocations; the process of transforming budgetary requirements into programs resulting in an efficient and productive work force. It is here that the mix of military personnel, civil servants, and contractual personnel is determined. Given the total number of allocated manpower spaces, the overall requirements of the operational functions to be filled are then matched with the manpower resource. Of course, if each year the same number of jobs were available to be filled by the same number of people, this exercise would have to be conducted only once. With no changes in the external influences on manpower and no alterations in the Pentagon plan, the need for the command level manpower manager would evaporate. The direction could then be provided by personnel researchers and cost effectiveness analysts who would simply determine the optimum distribution of the available work force.<sup>12</sup> Consistency, however, is not a byword when describing government operations.

Responsibility for the specific distribution of authorized manpower spaces ultimately rests with the individual at the field level. It is the duty of the Management Engineering Program, through the employment of the Management Engineering Team and Manpower Management personnel, to develop, maintain and apply manpower standards to the functional areas assigned.<sup>13</sup> The paperwork of the Pentagon and Command levels are translated into specific requirements such as number of workers, worker skills and worker skill levels. The goal of manpower management now becomes the development of the most efficient program of manpower utilization within

the established parameters.

The procedure to formulate an Air Force Manpower Standard is set forth in Air Force Manual 25-5. Portions of the Statistical Standards Proposal for the Commercial Services and Material Accounting and Finance function<sup>14</sup> are presented to illustrate the standard development process. While the analysis of manning requirements for each work center differ slightly, the Base Stock Funds Accounting Unit is representative of the manning determination process and will be reviewed to explain the first step of the military's manpower standard development. The analysis and manning determination procedure employed in this standard study is pertinent to consideration of the application of microeconomics.

A management engineering study team initiates the standards process by conducting preliminary research on the functional code in question.<sup>15</sup> During this phase, a Work Center Description<sup>16</sup> is developed to specify each duty and segment of activity the personnel of the unit actually accomplish. While the category headings are listed in the Air Force Manual,<sup>17</sup> the task descriptions are unique for each work center studied. Differences occur in computer capability, automatic equipment availability and locally modified accounting procedures. Therefore, a description of each facet of each work center operation is required.

Subsequent to the completion of the Work Center Description, two determinations must be made by the study team. First, a method of measurement of man-hour data must be selected. Secondly, a workload factor, representative of the total productive effort of the work center, must be chosen. The conventional Industrial Engineering procedures of time study and work sampling, in addition to operational audit and the more

advanced techniques of queing theory, provide the management engineer the tools to obtain the necessary man-hour information.

In the example study, work sampling was the primary method of measurement with operational audit being utilized to augment the sampling data. Eighteen work samples per day were taken for twenty working days. The cumulative results are presented in Appendix C with the leveled and allowed times calculated. The leveled time is the product of the pace rating factor, or leveling factor, and the measured time. The allowed time is determined by adjusting the leveled time for personnel rest times, and unavoidable delay. Using the productive time of this work center as a basis, the allowance factor was calculated to be 1.116. The information resulting from these computations is the total allowed time sampled for each of the productive categories. These figures are then entered in the appropriate blocks of the form as shown in Appendix D.

The time determinations entered in the operational audit columns of the form<sup>18</sup> are a result of personal interviews with various work center personnel. For example, in this particular work unit, an individual was assigned to an office in a separate location during the sample month. It was therefore necessary to quantify this position on the basis of task descriptions and man-hours provided by the employee doing the work. Quarterly or annual reports, employee evaluation forms, and employee counseling also had to be considered, converted to a monthly basis and added to the previously allowed man-hours.<sup>19</sup> The operational audit time is man-hours awarded to tasks from the work center description, not performed during the twenty sample days.



After computation of the total man-hours expended in the work center, the manning required to fulfill these hours is determined. At the present time, an individual is calculated to be available to a work center 144 hours per month.<sup>20</sup> Briefly, this figure is the result of decreasing the standard 160 hour work month for federal holidays, average annual and sick leave, educational training time and special absences as defined.<sup>21</sup> The required manning, given the present work volume, is then computed by dividing total man-hours by the 144 available hours per employee. In our example, this was 22.495 or 23 people for the Base Stock Funds. The proposed Air Force Specialty Codes, the skills and skill levels required, are then determined through consultation with the work center supervisor.

If an identical volume of work flowed through the center each month, the study team objective of developing a manning standard would be fulfilled. However, a workload factor must be developed to accurately reflect changes in the manning requirements, while being conducive to the development of manning projections provided by a programmable standard. Operationally, the chosen workload factor is the result of several hours of discussion, manual work counts, and correlation and regression analysis, if applicable, in an attempt to obtain the most representative count of work volume. The supervisory personnel of the work center, understandably, want credit for each unit of work accomplished. This would be the optimum situation. However, the mechanized systems involved usually do not provide cumulative data on every segment of work volume. It is obvious that personnel could not be assigned to manually count the work someone else is performing. Therefore, the workload factor chosen

must be reliable, readily available, and representative of fluctuations in the total work volume of the center. If historical data is available, statistical analysis affords the study team the opportunity to analyze the correlation of each suggested factor with the total volume of work previously accomplished. Once again, current reporting procedures are often deficient in the area of historical data, thereby eliminating the applicability of statistics.

Historical data was not available in the Base Stock Funds center. It was, therefore, necessary to determine the workload factor through the interview of supervisory personnel. Based on these discussions, the combination of two workload counts was chosen as the most representative figure, in addition to being reliable and available. Payment vouchers and Defense Supply Agency/Government Supply Agency (DSA/GSA) bill cards processed, weighted by a factor of ten to one, became the monthly workload count. The weight of each item was determined through time study of the processes involved. The result showed that one DSA/GSA bill card required .17 hours processing time, while handling a payment voucher expended 1.75 hours each. Workload counts for the sample month totaled 28.313 units after weighting, which was then converted to an entire month's data of 29,728.65 units.

Development of the manning equation is the next step the management engineering team undertakes. In our example, analysis determined a manning requirement of 22.495 or 23 people for a workload represented by a factor of 29,728.65 units. However, fluctuation in work volume necessary to require a manpower change, the subsequent workload points at which manning must be adjusted, and the applicable range of the

standard have to be calculated. The total allowed man-hours are now divided into the categories of fixed, variable, and personnel generated.<sup>22</sup> Consistent with the accounting definition of these terms, an Air Force manual<sup>23</sup> defines fixed hours as man-hours expended by a work center which do not exhibit a relationship to workload volume or work center size. Variable man-hours are expended hours which are directly proportionate to the total workload volume. Personnel generated man-hours do not show a direct relationship to the selected workload factor or remain constant: they are related to the total fixed and variable man-hours expended by work center personnel.

Appendix F reviews the specific breakdown of the Base Stock Funds Accounting man-hours and presents the development of the standard manning equation. The equation,  $Y = 102.43 + .1056X$ , determined the man-hours necessary to accomplish a workload represented by X, the reported workload factor. The final step of the equation development is the determination of extrapolation limits and workload breakpoints for conversion to manpower spaces.

Dependent on work center size, different constraints are applied to determine the extrapolation limits of the equation. In the Base Stock Funds Accounting work center  $\pm 15$  per cent of the base month workload is the range. Recomputation of the standard equation would be required if the twelve month moving average of reported workload data fell outside this range. The workload breakpoints, those figures requiring manning changes, are calculated by writing the manning equation in terms of X, substituting whole-person man-hour values for Y.<sup>24</sup>

The personnel and economic impact of the standards process on the

work centers studied is calculated over a three fiscal year range.<sup>25</sup>

The specific grade level of suggested manpower changes are entered and the costs determined using annual salary factors. An increase of personnel appears as a negative change due to the cost of that position. The effectiveness of the study is evaluated by the relationship of the monetary savings to the salary expenditures of the study team personnel.

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16. Appendix B shows the Work Center Description.
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19. Appendix E, Air Force Form 1040, shows the Operational Audit Data.
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23. Department of the Air Force, Air Force Manual 25-5, Management Engineering Policies and Procedures, (Washington, D. C.: U. S. Government Printing Office, August 8, 1973).
24. Appendix G tabulates the manpower requirements.
25. Appendix H shows the monetary impact of the Statistical Standards study.

## CHAPTER IV

## MICROECONOMICS

Although the economy of the United States is something less than the perfectly competitive world of the pure economic theorist, it is basically an economic system which relies upon the pressures of competition.<sup>1</sup> As such, by virtue of their demand preferences, purchasers determine which goods and services will be produced, and in what quantities, or discontinued. Consumer demands and choice patterns create the requirement of economic efficiency in the production and operation of the competitive organization.<sup>2</sup> The price mechanism of a capitalist economy requires the production of quality materials at a reasonable unit price. It is indeed paradoxical that the government regulating this economy is not influenced by either a price mechanism or the competitive force necessitating efficiency. In government, there is no profit lure, nor promotions or salary increases based on achievements. In fact, criteria of efficiency in government are not readily available and incentives to economize are rare. The diffusion of responsibility affords government decision-makers the opportunity to avoid the repercussions of choosing an improvident solution. At higher levels competition exists only with the opposing political force. The success of a political endeavor depends on factors other than the efficient utilization of resources.<sup>3</sup>

Suggested approaches to the improvement of government operations are as numerous as the texts on the topic. However, one consistently

presented explanation to economic waste relates to the military function. Analysts in the field propose the combining of limited quantities of weaponry to maximize deterrence be considered just as much a problem in economics as determining which combinations of raw materials in commercial production maximize profits.<sup>4</sup> In both cases, there are budget and resource constraints, in addition to the challenge of the correct measurement of goal alternatives.<sup>5</sup> This is not to say that the business of defense is analagous in every sense to commercial operation. For example, industry necessarily regulates the state of technology, for the market will not support unwarranted product developments. However, present technological development in defense does not heed to the unwillingness of the citizenry to support expenditures.<sup>6</sup> It is therefore necessary that the defense market become more "consumer" oriented; it must provide protection at a level the taxpayer can afford.<sup>7</sup>

Economic pressures require a new look at the defense posture of this nation. Analysis of military needs over the "long-haul" are becoming factors of primary consideration. The expenses required to maintain strategic nuclear capability, update weaponry, and insure force readiness poses a dichotomous problem. One interpretation calls for action based on the assumption that the future international developments will present a serious threat to our security.<sup>8</sup> This proposal leads to increased emphasis on military capability, thereby limiting monetary allotments of other governmental agencies. The military forces would be prepared for any contingency; however, the society it protects could economically deteriorate. Also, a spending program devoted entirely to long-range defense contains inherent dangers. The most serious being



the possible peacetime establishment of war-oriented societal controls.<sup>9</sup>

The antithesis states there is no reason for concern about this nation's security. Instead, any conflict could be resolved by political means. The proponents of this alternative suggest substantial reductions in military allocations. Reliance on diplomacy would replace dependence on the weaponry of defense. While certainly a pleasant and desirous situation, this seems utopian.

Accurate foresight of future defense requirements is impossible. Exacting scrutiny of each aspect of defense spending must be employed. The present structure of defense must, through efficient resource utilization, create an internal economic structure that will permit our nation to wage the cold war effectually and concurrently, reduce its vulnerability to hostile action and improve its position and power by extending its influence.<sup>10</sup>

Inherent in this process of economic analysis is the selection of the most efficient alternative in an attempt to maximize predetermined benefits or minimize loss.<sup>11</sup> Weighing the costs and gains of various strategies or actions is the process by which policies are derived. In the sense of an operational military decision, marginal cost-benefit analysis would concentrate on review of targets, defenses, type of weaponry selected, and possible enemy retaliation. The method of alternative analysis in this type military decision provides the foundation for extrapolation of the procedure into a manpower management environment.

For example, marginal analysis on a major planning level would involve the allocation of strategic missiles to fixed targets.<sup>12</sup> Given

a target list, the first allocation question is what missile assignment maximizes damage to the enemy? As the planner progresses beyond the assignment of one missile for each key city, the problem of diminishing marginal returns applies to each additional missile. Each small city added to the target list represents a decreasing "damage" return per missile. Each additional missile assigned to a large city enhances the attack effectiveness, for expected damage and the probability of the city being hit increases. The optimal assignment of missiles now becomes a decision pattern in which expected marginal returns are equivalent at each target.

An interesting hypothetical development is the enemy's installation of an anti-ballistic missile system (ABM). The opposing force will, naturally, place their ABM's around cities of value seeking to make an attack on each defended city of no greater consequence to the aggressor than an attack on an undefended city. If successful, the defender will lessen over-all damage for any number of attacking missiles. Additionally, the diminishing marginal return is offset over the range of missiles assigned by the offense to defended cities.

The focus shifts once again to the offense for determination of the disposition of missiles under these new provisions. Analysis of the marginal properties involved would result in a decision that either pursued an extensive attack, targeting undefended cities, or concentrate on attack effectiveness, by assigning more missiles to defended cities in an attempt to neutralize the ABM capability.

Irrespective of the final assignments made, it is clear that planners in this field are dealing with decisions that will significantly

affect defense budgets and requirements in the future. In addition to missile assignment by the offense and ABM deployment by the defender, positions must be reversed to analyze the effects of retaliation. The question is; at what point must a force assume the role of the aggressor or the defender in terms of the marginal returns?

Although the missile assignment problem has been presented as one subject to marginal analysis, its review as a gaming problem is appropriate. As initially hypothesized, the situation may be formulated as a one-person, non-zero-sum game. The ABM capability of the defender can only reduce his expected loss, with the attacker being concerned solely with damage to the enemy. Given the stated problem description and the difficulty associated with this type game, a fictitious player must be created, thereby forming a two-person zero-sum game. This procedure is presented by John Von Neumann and Oskar Morgenstern in Theory of Games and Economic Behavior as a solution to the problem. When the defender develops retaliatory capability, the fictitious player is eliminated, for both participants are involved in the strategic decisions accomplished.

#### The Utilization of Microeconomics in Defense: An Example

The presentation of the missile assignment problem affirms the position that military decision processes subject to economic analysis do exist. Entire defense structure capability can be quantified through marginal concepts. This analysis is not limited to consideration of system-wide alternatives. Instead, each component of the overall system should be the result of marginal analysis procedures, again with the

ultimate goal the highest level of defense capability for the absolute minimum expenditure feasible.

Consider an example of component procurement involving alternative weapon systems within a fixed budget.<sup>13</sup> Analyze product transformation or, how many missiles and/or bombers are needed to carry out the required tasks. Where the planner in the previous example had to deal with missile assignment only, he now must choose the optimum combination of defense systems to afford the greatest strike defense, or deterrence capability. Figure 3 illustrates the infinite decision possibility points available to the planner.<sup>14</sup> In the case under review, X represents the number of missiles required; Y represents the number of bombers needed. However, X and Y could be any variety of alternatives: the amount of strategic force as compared to the level of air defense; the level of tactical forces as compared to airlift capability; the level of

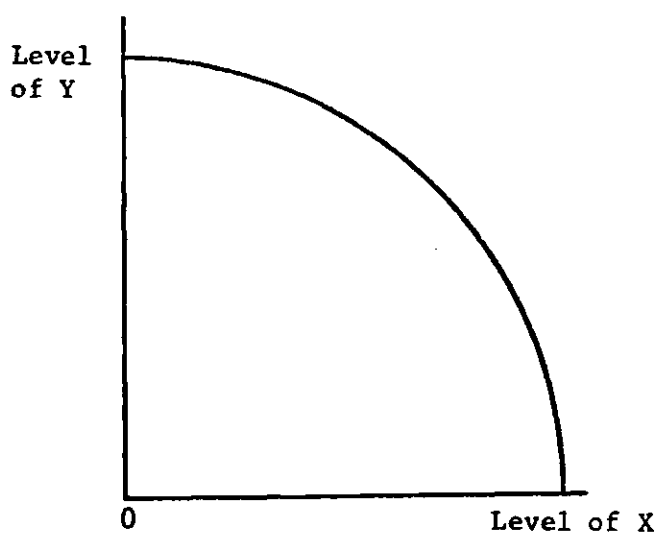


Figure 3. Decision Point Variables

air power compared to ground forces. Clearly, the applicable product choices for X and Y range from intrasystem to total defense department capability levels. Time-cost tradeoffs can also be analyzed in terms of the budgetary constraints applied. The resultant development of a possibility curve permits selection of the point at which the particular system in question should be budgeted and scheduled.<sup>15</sup>

Specifically, let  $X_i$  represent the extent to which each weapon system is employed; the number of bomber wings or missile squadrons in this case. If there are n such systems, there will be n variables designated by subscripts  $X_1, \dots, X_n$ . If the index of overall strategic power or effectiveness is E, the problem is to determine the maximum of E subject to the budget limitation. The contribution of one extra unit of  $X_i$  to E, holding all other variables constant, is the marginal product of  $X_i$ .

The budget limits the permissible combination of the variables  $X_1, \dots, X_n$ . Obviously, the cost of some combinations is far too expensive. If the cost per unit of  $X_i$  is a constant  $P_i$ , then the budget limitation can be expressed by:

$$B - \sum_{i=1}^n P_i X_i \geq 0$$

where B is the budget in dollars. If no further restrictions are placed on E, the maximum combination of the  $X_i$ 's must be determined by a comparison of the possibilities. While a tedious process, the problem of determining resource allocation is eased by its adherence to the general law of diminishing marginal return. In other words, if one system or

input is substituted for another, with all other inputs and  $E$  held constant, the terms of which substitution can be made will become decreasingly favorable. Assume the value of  $E$  and all but two  $X_i$ 's,  $X_1$  and  $X_2$ , are constant. Starting with any pair of values of  $X_1$  and  $X_2$  that are consistent with the value of  $E$ , the increment of  $X_2$  required to maintain a constant  $E$  while varying  $X_1$ , is of interest. If  $E$  is subject to the law of diminishing marginal returns, consistently increasing amounts of  $X_2$  will be required to offset the successive reductions in  $X_1$ . To illustrate, assume a force of one hundred bombers and one hundred missiles. Also, assume that at this level, the effect on  $E$  of reducing the bomber force by ten is offset by increasing the missile force by eight. If  $E$  obeys the law of diminishing marginal returns, more than eight missiles will be required to offset a second reduction in the bomber force by ten. This could be explained in terms of equipment capability: certain missions are performed more successfully by bombers, some by missiles, and others when the weapon is interchangeable. As the number of bombers is reduced, the extra missiles must be used in tasks that are successively greater suited to bombers. It may correctly be expected that many missiles would be required to offset the loss of the last few bombers.

Alternative combinations of  $X_1$  and  $X_2$ , with a constant value of  $E$  and all other  $X_i$ 's are graphically depicted by Figure 4. While the curve itself is an equal output line, or isoquant of  $E$ , the slope of this isoquant is equal to the negative ratio of the marginal products, or, the marginal rate of substitution. This property indicates the rate at which  $X_1$  can be substituted for  $X_2$  with  $E$  constant. The Law of Diminish-

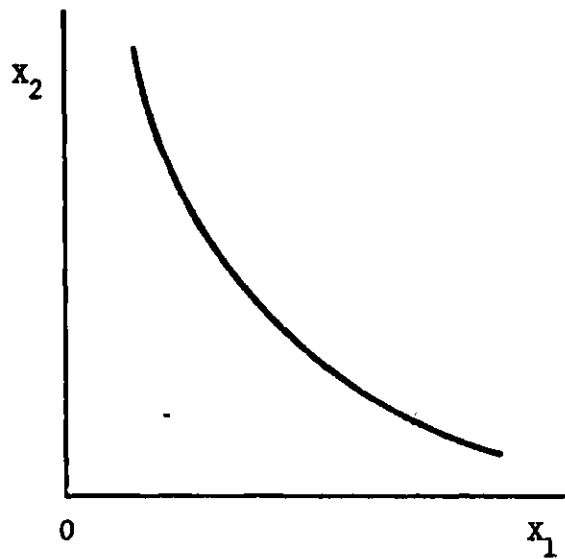


Figure 4. Combinations of  $X_1$  and  $X_2$  With Constant  $E$

ing Marginal Returns implies that the ratio decreases as  $X_2$  increases. For example, if one bomber is added to a force of one hundred bombers,  $E$  will increase less than if one bomber is added to a force of ten bombers. Similarly, the addition of two missiles and two bombers to a force of fifty missiles and one hundred bombers will increase  $E$  less than the same addition to a force of five missiles and five bombers.

After a point, the procurement of many weapons systems display constant or increasing average costs. If the cost per unit increases as the number of units purchased increases, and the rate of increase is constant or itself increasing, the relation is simply a normal supply curve. If the average cost per unit for the  $i^{\text{th}}$  input is,  $P_i = S_i(X_i)$ , the cost of one extra unit of the  $i^{\text{th}}$  input is equal to  $P_i$ , the average cost plus the change in average cost or price multiplied by the number of units for which it must pay. This cost is defined as the marginal cost.

The fundamental principle involved in this exercise is that of marginal comparison. An increase in the use of the  $i^{\text{th}}$  system or input by one unit has been shown to increase  $E$  by the marginal product of that input. However, the existence of constraints limits "free" increases in any input. After some level, an increase in any  $X_i$  will have to be accompanied by a reduction in the use of other inputs, thereby reducing  $E$ . The marginal cost of each input can, therefore, be computed; that is, the minimum reduction in  $E$  made necessary by an increase of one unit in the use of that input. As long as it is possible to find inputs whose marginal product exceeds their marginal costs, it will be possible to increase  $E$ . A relative maximum will be achieved when no further increases are possible; when the marginal product of each input equals its marginal costs.

While the examples presented deal with specific aspects of the defense problem, it should be understood that application of marginal economics is not restricted to these topics. As mentioned, every phase of weapon system, force composition or entire department planning, is subject to similar analysis. Current use of linear programming affords the planner the opportunity to quantify marginal properties into system constraints, then maximize an objective function as determined by the applicable budget specifications. Of course, given the technical capabilities of each defense weapon system or unit, infinite product mix determinations can be generated.

The manpower resource and system requirement level is also considered in the procedure of defense structure determination. Planners formulate the manpower constraint with methods analogous to those em-



ployed in the problem of weapon systems. The final result is the number of authorizations required for the particular force component. For example, if a requirement of four strategic bomb-wings is determined, the manpower constraint may dictate assignment of four thousand spaces; one hundred missile sites may be allocated one thousand authorizations. However, specific analysis of the manpower allocations themselves is, at the present time, nonexistent. The manpower management procedures may be employed to determine the specifications of these assignments. As herein hypothesized, marginal economics may be utilized to provide more accurate and efficient allocations of human resources.

## FOOTNOTES FOR CHAPTER IV

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3. Charles J. Hitch and Roland N. McKean, Elements of Defense Economics, p. 2.
4. Ibid., p. 69
5. Gordon F. Smale, ed., A Commentary on Defense Management, p. 25.
6. "Contracts in Defense Business", Aviation Week and Space Technology, C (April 1, 1974), p. 9.
7. "Economic Policy: What To Do?", Newsweek, (September 30, 1974), p. 76.
8. Barry M. Blechman, Edward M. Gramlich, Robert W. Hartman, Setting National Priorities: The 1975 Budget, p. 97.
9. Donald H. Wallace, Economic Controls and Defense, p. 4.
10. Charles J. Hitch and Roland N. McKean, The Economics of Defense in the Nuclear Age, p. 18.
11. Vivian Charles Walsh, Introduction to Contemporary Economics, p. 17.
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13. Hitch and McKean, op. cit., pp. 110-114.
14. Edwin Mansfield, Microeconomics, p. 196.
15. Merton J. Peck and Frederic M. Scherer, The Weapons Acquisition Process: An Economic Analysis, p. 286.

## CHAPTER V

## THE AIR FORCE CLINICAL LABORATORY AUTOMATION SYSTEM

The Air Force Clinical Laboratory Automation System (AFCLAS) project, directed by the Office of the Air Force Surgeon General (AF/SG), is a computer based administrative information system designed for implementation in the clinical laboratories of the Air Force's medical centers and hospitals. While the system primarily affects the administrative function of the laboratory, it also concerns the manpower aspect of the section, for manning requirements could change upon the introduction of AFCLAS. The Surgeon-General has approved the acquisition of two AFCLAS units: one to be located in the Wright-Patterson Air Force Base Medical Center, Dayton, Ohio; the second in the Malcolm Grow Medical Center, Andrews Air Force Base, Washington, D. C.

Thirty days prior to the commencement of AFCLAS operation, the two clinical laboratories involved will be studied in terms of manning, time spent on administrative duties, the time required to determine results of medical tests and return the results to the physician, etc. Thirty days after system acceptance by the Air Force, the same aspects of laboratory operation will again be measured. Based on comparative analysis of the information, the decision will be made as to the purchase of ten additional Air Force Clinical Laboratory Automation System units to be distributed to other Air Force medical centers.<sup>1</sup>

While the primary objective of the Air Force Clinical Laboratory Automation System is improvement of the internal operation of the clini-

cal laboratory, its impact on other hospital functions is significant. In the laboratory itself, simplification of reporting, more efficient storage and retrieval of test results, the reduction of the duration of these tasks, and facilitation of the preparation of the administrative reports are advanced as the benefits of the system. External functions are expected to benefit from the increased accuracy of laboratory reports, expanded physician use of these reports, reduced response time for completing requested laboratory work, and decreased filing time of laboratory reports in the patient medical records.<sup>2</sup> The eventual, and ultimate, effect of AFCLAS is hypothesized to be a significant increase in the quality of patient care. The evaluation of the system, and basis for the final procurement decision is the system's achievement of objectives in three areas: (1) dollar benefits and costs of AFCLAS; (2) acceptance of, and satisfaction with, AFCLAS by hospital personnel;<sup>3</sup> (3) and the incommensurable effects involved,<sup>4</sup> i.e., timeliness and quality of laboratory product, quality of patient care, generation of new administrative reports, and research value of the system.

The benefit and cost analysis will determine the net dollar value of changes affected by AFCLAS throughout the hospital, including the cost of the equipment itself. A positive net cost of AFCLAS must be weighed against the advantages that are not quantifiable in terms of dollars. This analysis will be based on information obtained during the two data collection periods: Period X before the installation of AFCLAS and Period Y after the system is operational. Comparison of the data from these two intervals will determine system potential.

As stated, the objective of the dollar benefit and cost analysis

is to determine the economic value of AFCLAS and the changes which evolve therefrom.

$$\begin{array}{rcl} \$ \text{ Direct Cost} & + & \$ \text{ Change in Other} \\ \text{of AFCLAS} & & \text{Facility Operating Costs} = \text{Net \$ Cost} \\ & & \text{of AFCLAS} \end{array}$$

The anticipated effect of AFCLAS that will yield the greatest cost change,  $\Delta C_A$ , to the facility is a reduction in the time required to carry out the routine tasks of operating the laboratory. Other cost changes with dollar value that will be included in the analysis are changes in tasks outside the laboratory.  $\Delta C_B$ ; changes in the consumption of paper forms,  $\Delta C_F$ ; and changes in the number and/or kinds of specimens sent to other laboratories for processing.  $\Delta C_S$ ; or:

$$\begin{array}{l} \$ \text{ Change in Facility} \\ \text{Operating Costs} \end{array} = \Delta C_A + \Delta C_B + \Delta C_F + \Delta C_S$$

The first cost change to be determined is that of laboratory staff time saved or additional time required as a result of task changes after the introduction of AFCLAS. A task change for the laboratory staff may be defined as a change in the number of times the task must be done or a change in the procedure for performing the task.<sup>5</sup>  $\Delta C_A$  is the dollar value of the difference between the laboratory staff time required to do the tasks considered during Period Y (with AFCLAS) and the time that would have been required for these tasks without AFCLAS. The latter time requirements are to be determined by adjusting Period X requirements to the Period Y workload.

$$\Delta C_A = \sum_{i=1}^{18} \Delta C_{A_i}$$

where 18 = the number of tasks subject to change.<sup>6</sup>

$-C_{A_i}$  = the dollar cost change in manpower for task i, of having AFCLAS during Period y.

$$\Delta C_{A_i} = \sum_{j=1}^K \left( \frac{(2)(2)(2)}{P_{ij}^{(2)} Y_i^{(2)} h_i^{(2)}} - \frac{(1)(1)(1)}{P_{ij}^{(1)} Y_i^{(1)} h_i^{(1)}} \right) c_j$$

$i=1,2,\dots,n$

where;

k = number of laboratory personnel categories.

$c_j$  = cost per hour of personnel category j in Period Y.

$Y_i^{(t)}$  = number of units of task i that would be associated with the Period Y workload for the manual system (t = 1) and with AFCLAS (t = 2).

$P_{ij}^{(t)}$  = fraction of the total time required for task i that is routinely contributed by personnel in category j with the manual system (during Period X) (t = 1) and after introduction of AFCLAS (during Period Y) (t = 2).

$h_i^{(t)}$  = number of hours required to do one unit of task i with the manual system (t = 1) and with AFCLAS (t = 2).

If there is no difference between the number of task i units with the manual system and with AFCLAS, then  $Y_i^{(1)} = Y_i^{(2)}$ . Similarly, if the time required per unit of task i is the same with the manual system and with AFCLAS, then  $h_i^{(1)} = h_i^{(2)}$ . The value,  $\Delta C_A$ , as it has been described, is based on a comparison of laboratory operations during the two periods of data collection. The effects of intervening factors such as equipment changes (other than AFCLAS), seasonal variation in the laboratory

workload, the rate of change of the laboratory workload, and the rate of change in costs will be considered to generalize and project the results.

The cost changes for the tasks outside the laboratory will be determined in the same manner as for those inside the laboratory. The tasks of filing laboratory results in the medical records department and at the nursing stations will be considered in this category. The equation representing  $\Delta C_{A1}$  will be employed to evaluate  $\Delta C_B$ , the cost change in laboratory-external manpower dollars of having AFCLAS during Period Y.

A reduction in the cost of the paper forms used for laboratory operations may result from the introduction of AFCLAS. This is because costly three part carbon request slips will be replaced by single copy mark sense cards and many laboratory worksheets and logbooks will be eliminated. The value of such a cost reduction to the laboratory is  $\Delta C_F$ , the change in paper forms cost of having AFCLAS during Period Y.  $\Delta C_F$  is the difference between the cost of using paper forms associated with the manual system (those in use during Period X) during Period Y, and the actual cost of paper forms used during Period Y (with AFCLAS), adjusted for non-AFCLAS introduced changes.

One way that the laboratory may use the manpower released by AFCLAS is by processing specimens in the laboratory that would have been sent to other laboratories prior to the introduction of AFCLAS. The value of such a change to the laboratory is the price that would have been paid to the outside laboratory, reduced by the labor and materials cost of processing the specimen inside the laboratory. The dollar value

of the change may be written as:

$$\Delta C_S = \left[ \sum_{o=1}^K (V_{1o} W_1 C_o Z_1) + M_1 Z_1 \right] - \sum_{i=1}^l S_i Z_i$$

where;

- $l$  = the number of kinds of tests for which specimens were sent to other laboratories for processing prior to introduction of AFCLAS (during Period X) and which are processed in the laboratory after introduction of AFCLAS.
- $s_i$  = average Period Y price for performing test  $i$  at the facilities used during Period X to perform that test.
- $z_i$  = total number of test  $i$  specimens processed during Period Y (with AFCLAS) that would have been sent to another facility during Period X (i.e., without AFCLAS).
- $c_o$  = hourly cost of manpower category  $o$  in Period Y.
- $v_{1o}$  = fraction of the total personnel time required to perform test  $i$  in the laboratory that is contributed by personnel in category  $o$ .
- $w_1$  = total personnel time in hours required to perform test  $i$  in the laboratory during Period Y (with AFCLAS).
- $m_1$  = cost of materials required to perform test  $i$  for one specimen during Period Y.

This expression assumes that the decision to perform new tests in-house would be made only where the costs of additional facilities, equipment, and training to establish the capability to perform the tests would be small in relation to the value of  $\Delta C_S$  when amortized over an appropriate



operational period.

In addition to the dollar value of the task changes in the laboratory, the change in required man-hours is also of interest. The value to be determined is the difference between the time required to do the tasks considered during Period Y (with AFCLAS) and the time that would have been required to do these tasks without AFCLAS.

$$H = \sum_{i=1}^{18} H_i$$

where;

$H_i$  = value in man-hours required for task  $i$  of having AFCLAS during Period Y.

$$H_i = \sum_{j=1}^K \left( \begin{matrix} (1)(1)(1) & (2)(2)(2) \\ P_{ij} Y_i h_i & - P_{ij} Y_i h_i \end{matrix} \right)_{i=1,2,\dots,n}$$

where all variables are as defined for the equation representing  $\Delta C_{A_1}$ .

The time changes,  $H^j$ , may be broken out for each personnel category by calculating:

$$H^j = \sum_{i=1}^n \left( \begin{matrix} (1)(1)(1) & (2)(2)(2) \\ P_{ij} Y_i h_i & - P_{ij} Y_i h_i \end{matrix} \right)_{j=1,2,\dots,n}$$

where, once again, all variables are as previously defined.

The changes in the behavior patterns of those individuals interacting with AFCLAS involve personnel acceptance and satisfaction with the system. The reactions of the laboratory staff, physicians, support

staff, and patients impact the economic analysis previously presented. In the laboratory, forced changes in tasks or procedures might create resistance to system acceptance. Factors such as substandard individual performance or frequent personnel turnover would be a reflection of opposition to AFCLAS.<sup>7</sup> The results of the equipment installation, on the other hand, could be beneficial in terms of employee reaction. Measures of improved performance or decreased turnover would then be indicative of system acceptance.

Similarly, the reactions of the physicians and support staff may or may not be favorable. Test request patterns or report demands may increase significantly due to the greater capability of this automated system. Physicians may take advantage of laboratory service by ordering complete batteries of tests instead of selective diagnostic procedures. The result of the sequential testing process could be diagnosis based on the most accurate information. Support personnel interested in the statistical analysis of test results may utilize the reports incorporated in the system's software. This capability affords research of factors such as local environmental or occupational health effects.

Consideration must be afforded the hospital personnel opposed to the new system. Individuals hesitant to entrust test results to a mechanized process will either circumvent the system entirely, or tax its capability to the fullest extent. The latter action in the hope that the final determination of AFCLAS will be its rejection due to inability to handle the required workload.

The attitudes of the patients are also effected and must be taken into consideration. The resultant changes in the patient utilization of

hospital services will provide quantitative analysis of the effects of AFCLAS. Enhanced patient satisfaction with the medical facility involved will be reflected by increased workload values. Conversely, if the introduction of AFCLAS is followed by a reduction in patient demand, inference as to the unacceptability of the system can be made.

Equally important is the evaluation of the incommensurable effects of AFCLAS. The timeliness and reliability of the laboratory product, quality of patient care, generation of new administrative reports, and research value of the system are factors which require consideration. Unfortunately, quantification of these factors is as difficult as determining the economic value of clean air.<sup>8</sup> While the benefits of ecological efforts is implicit, attempted monetary analysis are exercises in futility.

An important objective of the laboratory is to provide accurate test results to physicians as quickly as possible. Thus, a reduction in request processing and reporting time as a result of AFCLAS would be a positive contribution of the system. Installation of AFCLAS will enhance the reporting of results by placing on-line remote terminals in locations possessing the highest requirement for immediacy. Associated with the concept of timely reports is consideration of reliability. An accurate report is mandatory in a medical environment involving patient health. The introduction of AFCLAS is expected to provide increased reliability due to the reporting procedures inherent in the system.

As stated in the discussion of the effects of patient acceptance, the hospital exists to serve its patients. The ultimate goal of the hospital is, therefore, optimum patient care. The ultimate goal of AFCLAS

is the improvement of the laboratory function in an attempt to aid the hospital in the attainment of its goal.

The generation of new administrative reports is subject to a quasi-economic evaluation. The value of the reports is a function of how frequently they are used, by whom they are employed, and their utility. However, the dollar value cannot be calculated solely by comparison to the cost of manually produced reports. The expense lies somewhere between zero, a free by-product of AFCLAS, and the cost of the effort the laboratory would expend to obtain the report if the automated system did not exist. While the determinant would be a dollar amount, the personal subjectivity involved in the development of the reply necessitates inclusion of the newly generated reports in the review of the incommensurable effects.

Finally, another non-dollar benefit is the potential research value of the system. Through the retention and analytical properties available, trends in results may be observed with normals established. Test comparisons could be made of physiological, generic or possible environmental variations in patients. This comparison could produce findings of sufficient value or interest to warrant subsequent evaluation as the key to a cure for disease. However, quantification of this development probability is too complex to ascertain at this point of system evaluation. The research contribution must, therefore, be assessed through qualitative methods and applied against a positive net cost of AFCLAS.

The costs of AFCLAS must be offset by the monetary savings and non-dollar benefits afforded by the installation of the equipment.

Should the change in internal and external man-hours, of paper consumption, and of specimens processed in-house result in a savings less than the direct expense of AFCLAS, consideration must be given to the behavioral acceptance and incommensurable effects of the system. When considering the Application of Microeconomic Theory to Manpower Management, the AFCLAS project is of value as an example of concurrent utilization of economic and non-dollar evaluations in the manpower related decision. It is hypothesized that the same procedures of effect analysis may be employed in the process of manpower management.

## FOOTNOTES FOR CHAPTER V

1. The evaluation plan for the AFCLAS system is the result of the combined efforts of personnel from the Air Force Surgeon-General's Office, Analytical Services, Inc., and the Management Engineering Teams of Andrews Air Force Base and Wright-Patterson Air Force Base. My involvement began in November, 1974, with the development and application of the selected analytical procedure in a pre-test exercise at the Keesler Air Force Base Medical Center, Biloxi, Mississippi. At the time of this writing, the Period X measurement plan, modified as a result of this pre-test application, is being conducted at the Wright-Patterson Air Force Base Medical Center by Lieutenant Gerald R. Riley and myself.

2. Honeywell Automation Systems, Inc., "AFCLAS Clinical Laboratory System Summary Description", Minneapolis, August 7, 1974, p. 7 (mimeographed).

3. Paul Enzig, The Economic Consequences of Automation, p. 58.

4. Charles J. Hitch and Roland N. McKean, Elements of Defense Economics, p. 123.

5. Appendix I shows the tasks hypothesized to change.

6. Appendix I.

7. Edwin Mansfield, The Economics of Technological Change, p. 159.

8. Robert Heilbroner, Understanding Microeconomics, p. 142.

## CHAPTER VI

### MICROECONOMICS AND MANPOWER MANAGEMENT

The apparent autonomy of the topics presented thus far is indicative of the incoherence of operations in defense. Recognizing the present economic conditions which require frugality, it is evident that the concepts employed in manpower management, weapon system procurement, and equipment purchasing must be combined in a manner affording the most exacting analysis of the specific problems of each function. However, in a time when the implementation of new approaches is appropriate, the defense structure is belatedly concerned with the feasibility of developing these modified procedures. Moreover, in the case of manpower management, the few directives suggesting method improvement have been the result of an incomplete review of factors involved.

Specifically, the Work Center Description,<sup>1</sup> for the sample work unit previously discussed, presents an exacting analysis of each task performed. All times are divided into the major classifications of direct and indirect hours. Reference to Appendix C also reveals the categories in which the time measurement results are placed. However, as a review of the process employed to develop the manning equation points out, the man-hour data is categorized as Fixed, Variable, and Personnel Generated Time. The conversion of hours from Direct and Indirect, as presented in the Work Center Description, to the three classifications listed, is virtually impossible.

The study presented had been completed utilizing the procedures

of fixed cost determination established by the appropriate Air Force manual. Originally, the work center's fixed costs were based on the minimum personnel requirement deemed necessary to operate the unit. This determination resulted in the assignment of 144 man-hours of clerical and administrative work as the basic manning level. The ratio of indirect man-hours calculated from the time measurement procedures, was then applied to the 288 man-hour requirement, with the resultant figure being the work center's fixed man-hour cost. The combination of fixed costs with the variable man-hour requirement as related to the increasing workload amount, formed the manning equation.

The apparent concern for economy led to the hypothesis that if the work center's fixed costs were reduced, the total resource and therefore, total expenditure requirement would correspondingly decrease. The subject study was revised, and the new process<sup>2</sup> implemented as standard procedure. While the intuitive solution to the discrepancy of man-hours classification is to alter the format of the Work Center Description, the analysis of the modified process reveals the false economy of the revision.

Equation A, the original manning formula, represents a higher resource requirement at lower levels of workload than Equation B, the revised curve. However, as the workload increases to the range of present operation, more man-hours are required by the manning standard represented by Equation B. The shaded area depicts the difference in manning requirements or the loss in the manpower resource.

In addition to the false economy of the modified fixed cost, approach, the entire manning standard development process is in complete



disregard of the ultimate determinant; the budget resources available. At the present time, current appropriations allow the assignment of 80 per cent of the calculated manpower requirements, irrespective of workload increase and related man-hour fluctuation. The money allocated to support the local work force will govern the utilization of manpower. It is ludicrous to incur the dollar expenditures and related effort of a manning standard, when the results of the process do not reflect the constraints imposed by reality.

The deficiencies of the present procedures ought to be realized. Current methods of manpower determination are as accurate as measuring the circumference of a circle with a ruler.<sup>3</sup> Manning standards are currently being developed under the pretense of efficiency in the allocation of the manpower resource. However, the resultant standard is not utilized in the assignment process. The superficial exercises of manpower officials must cease, and appropriate attention be devoted to concepts which will afford the most efficient analysis of manpower utilization.

As a result of the research into the field of microeconomics and the analysis of current manpower procedures, I propose a significant revision of the manning process. The suggested method incorporates the economic and behavioral concepts employed in the example determinations of weapon system and equipment procurement.

Given the budget constraint imposed on each functional area or Work Center, the problem confronting the manpower manager is analogous to the weapon system configuration exercise. The missile/bomber decision attempted to maximize E, the overall effectiveness of the weapon force. In the manning problem, efficiency in the utilization of the manpower

resource is of utmost concern. While manpower is the only input, there is a tradeoff involved with the cost of expected output derived from the assigned manning. Unlimited dollar reserves would allow the "free" addition of manpower spaced, but reality required increases be weighed against the cost of the subsequent product. The problem of standard development, in the marginal approach, is the determination of the point at which the marginal product of labor equals the marginal cost of the output of that labor. This will determine the manning standard, and will insure a more efficient manpower expenditure.

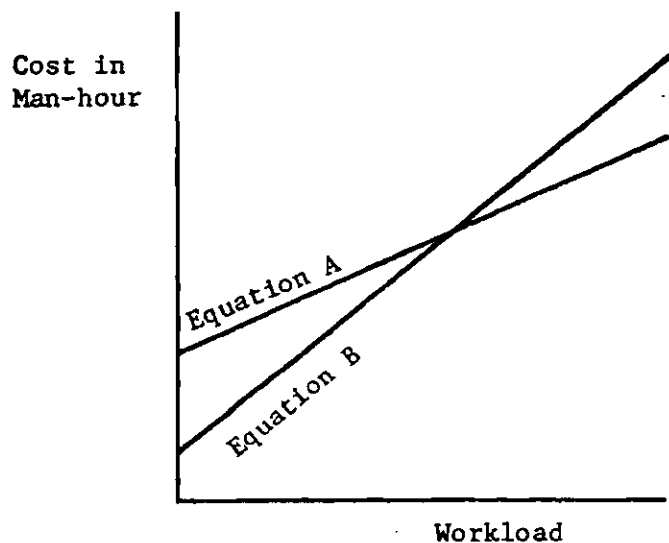


Figure 5. Manpower Equations

Presentation of the Air Force Clinical Laboratory Automation System evaluation plan illustrates consideration of the effects of personnel reaction to any alteration in the work environment is of fundamental importance. The findings of the classic Hawthorne experiments,

in addition to subsequent work by social behaviorists, substantiate this claim. It is, therefore, in order to examine the assumed linear relation between man-hour and the expected workload.

The development of the manning standard as illustrated in Appendices F and G, is based on the assumption that each man-hour of labor results in a constant level of output. As the workload level is fluctuated, an identical value is employed to determine required manning. While acceptance of the validity of this assumption simplifies the manpower standard determination, it is in direct contradiction to behavioral research. Other factors effect productivity within the range of the manning scale. If undermanned, the work center personnel will exhibit indifference to the overwhelming workload, and a general disregard for satisfactory performance. However, if overstaffed, the loss of individual identity, decreasing sense of individual responsibility, and adverse reaction to additional supervision will result. Assume an output curve as illustrated in Figure 6.

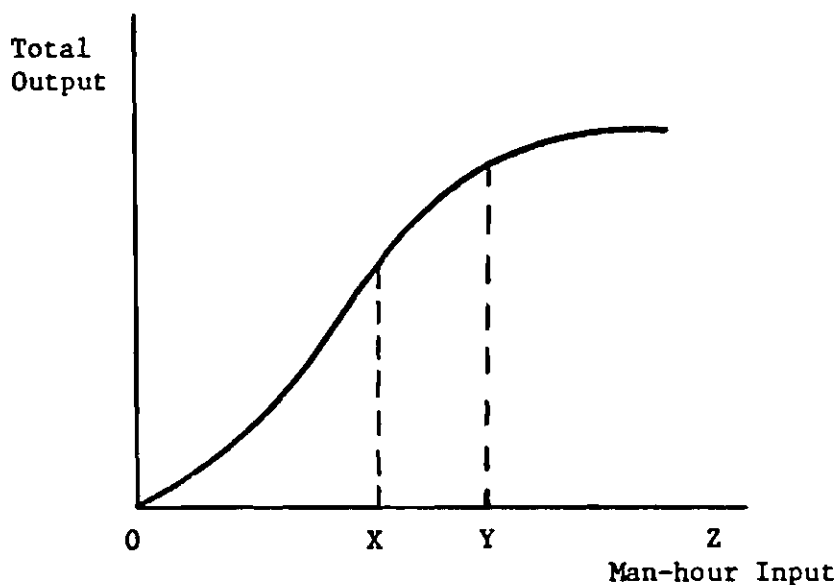


Figure 6. Total Product

Within the O-X and Y-Z intervals, the factors previously recognized are significant. The man-hour values represented by X-Y are the span of allocations which are most effective. Further analysis of the curve will determine the total impact of the manpower assignment.

The marginal product of the man-hour input is of interest. It is shown diagrammatically in Figure 7.

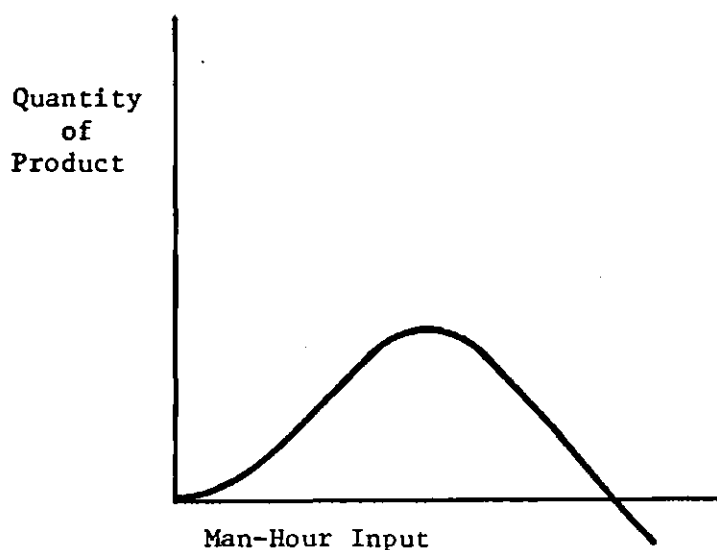


Figure 7. Marginal Product

As initial man-hour assignments are executed, the return in units of output per additional man-hour is increasing. The maximum marginal product is the point at which the greatest increase in output per additional man-hour occurs; the manning level above which the behavioral influences become functional. Man-hours assigned above the maximum marginal product result in a decreasing return of output. Each man-hour increase will have a consistently lessening effect. As in the discus-

sion of the missile assignment problem, the law of diminishing marginal returns governs. For each additional increase in man-hour input, a diminishing increase of output units occurs.

In an environment of unlimited dollar reserves, the selected operational man-hour level in terms of the marginal product is debatable. If manpower is to be utilized at the highest level of efficiency, the point of maximum marginal product would determine the man-hour allocations. However, this assignment would not necessarily result in the maximum level of total output. Graphically:

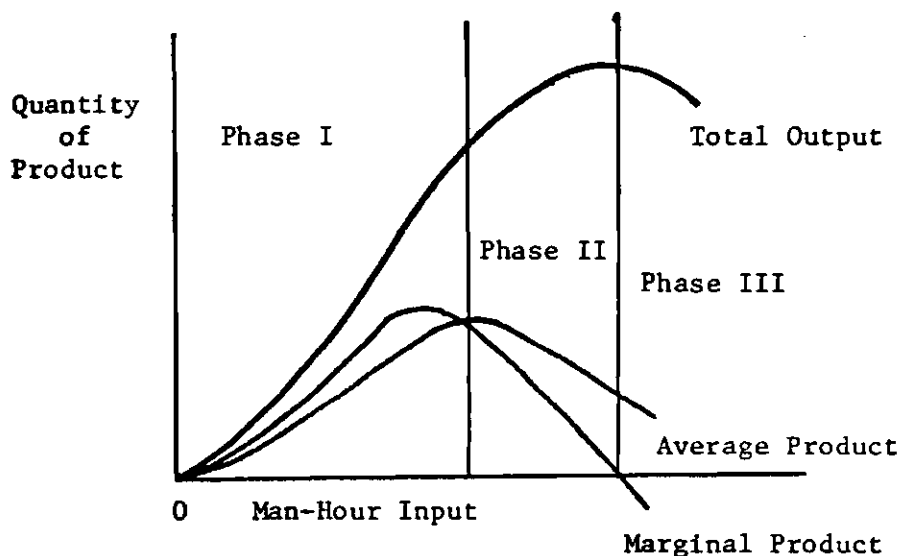


Figure 8. Phases of Production

Phase I depicts the area in which the marginal product is at a maximum. As stated, if efficient utilization of the manpower resource were the only consideration, this range of operation would be acceptable. Each individual would be at peak productivity. Phase III represents a total-

ly inadequate mode of production. The total output of the work center is approaching a constant level in spite of increasing man-hours. The average product is decreasing and the marginal product of additional manning has entered the negative region. Obviously, man-hours are being squandered if the function reaches this point. Phase II shows the appropriate interval for effective functioning given the conditions of an unlimited dollar supply. While the marginal product is in obedience of the law of diminishing returns, the levels of the average and total productivity balance this inefficiency of expenditure. If work center productivity were the ultimate criterion, operation in this area would be desirable.

In the development of a manning standard, the optimum "personnel mix" and related productivity level must be determined prior to the marginal analysis of the work center. The selected combination of personnel skills and skill levels is formulated in accordance with Air Force guidelines,<sup>4</sup> and supervisory discretion. It is the responsibility of each work center's supervisory personnel to determine individual manning configurations. Therefore, supervisory preference and experience significantly effect marginal properties of the work center output. The manpower specifications chosen by the supervisor quantify the man-hour structure in the pertinent interval of study.

Additionally, the increase in output corresponding to the additional man-hours should be determined. The previous personnel mix exercise is of no value if the varying productivity levels of different grades or rank are not quantified. Although a complicated process, the standardization of expectant output levels, categorized by skill and

skill proficiency, is perhaps the most significant step in the suggested manning process. Present procedure assumes a consistent monthly output for each manpower space (144 man-hours). Consideration is not afforded the fact that training programs and learning processes often invalidate this assumption. A work center staffed by individuals each having less than one year's experience certainly cannot function as proficiently as the same work unit manned by personnel, each of whom possess ten years experience. However, present practice does not identify the allotted man-hours as experienced or trainee. Instead, each allocated individual represents 144 resource man-hours. This error in the current method should be corrected. A marginal approach, as herein formulated, would require the assignment of specific output values to each man-hour assigned.

An obvious omission in the previous discussion is the consideration of cost. The budget constraints, ignored by present methods, are also important determinants in the manning process. The parameters imposed on manpower funding establish the limitations which require a marginal manning approach.

Just as the productivity of varying man-hour levels is subject to marginal analysis, so, too, is the cost of the labor required to produce that output. A budget of sufficient quantity would alleviate this requirement, for the work center could be authorized a level of manning based on desired total output.

However, the fiscal problems necessitate the determination of the manpower level which, when given the marginal product configuration, will most efficiently utilize the limited manpower resource. The total output

curve is represented in Figure 9.

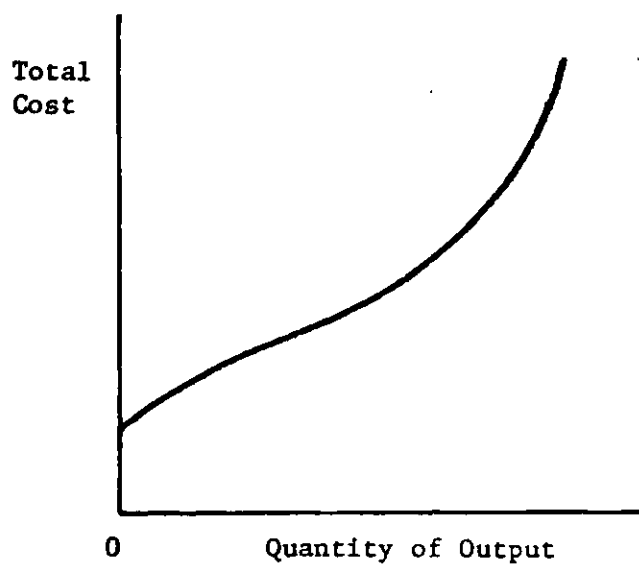


Figure 9. Total Cost

The marginal cost, the extra expense incurred with the production of each increment of additional output, is illustrated in Figure 10.

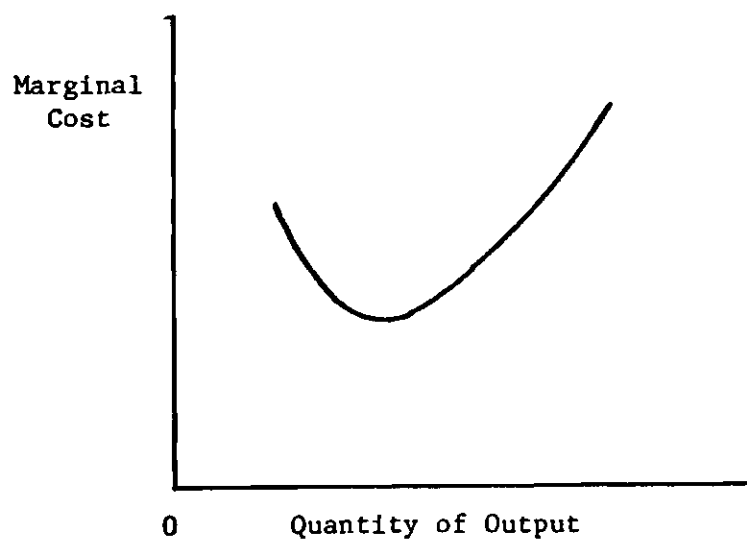


Figure 10. Marginal Cost.



These cost curves are obvious when the productivity analysis is considered. As the initial units are produced, the cost of man-hours expended is significant, resulting in a rapidly increasing total output cost. However, as the point of maximum marginal product is approached, the total cost of the output levels off, while the marginal cost is decreasing. As the output of the increasing man-hour allocation exceeds the minimum marginal cost value, sharp incremental increases in the cost of unit production and total cost result.

It is the concurrent comparison of the man-hour marginal product, and the marginal cost of the resultant output that determines the manpower standard. If the assigned man-hours corresponding to the output of maximum marginal product equals the output level resulting in the minimum marginal cost, optimality has been achieved. This man-hour allocation and output level would formulate the standard. However, a relative optimum is also acceptable, for the manpower standard would be the point at which sequential increase in the marginal product of assigned man-hours does not result in a subsequent decrease of the marginal cost of output.

The implementation of the manning standard is the next procedure in the manpower process. The budget constraints which define the range of possible personnel-mix combinations indirectly effect the determination of the expected output of allocated manpower. If the formulated standard results in an output level equal to, or in excess of, current work center productivity, the task of manpower management is complete. The work unit would, if necessary, restructure its manning classification as chosen by supervisory personnel and function at normal workload level.

As the analysis of external functions proceeds, reassignment of workload may occur. However, the unit would be expected to increase production only to the level determined by the standard.

When the manning determination results in an output level requiring a decrease in the current workload level, the implementation process increases in complexity. As shown, demands for output above the computed standard result in inefficient resource utilization and the development of a workload backlog. The decision must be made to reassign or eliminate work center responsibilities. Reassignment is the more facile solution. However, external limitations will eventually negate further reassignment as the plausible solution. The necessity for termination of specific responsibilities is apparent. Again, interaction with supervisory personnel is the most effective means of accomplishing this task. When the manpower structure and work center output conforms with the manning standard, the manpower management function is complete. Subsequent analysis of the work center could be required if the resource constraints imposed on the function are altered.

A hypothetical application of the marginal approach to the sample work center and related manning study illustrates some advantages and weaknesses of the proposed manning procedure. At the outset, one of the more significant benefits of marginal analysis is the elimination of the man-hour and resource expense incurred in the development of the manning study as presented in Appendices B, C, D, E, F, and G. While the wholesale abrogation of this data may seem extreme, the proposed method would, in fact, eliminate the work sampling, operational audit, clerical and administrative costs incurred to obtain this information.

Reference to Appendix H presents the man-hour expenditure of the individuals involved in this study. However, this cost does not reflect the clerical and administrative support required to complete the manpower standard. While the reported direct cost is accurate, the inclusion of overhead and indirect labor expenses places the study cost in excess of \$10,000. In addition, this expense will be incurred each time a standard is developed for this work center. While the information in these Appendices would certainly aid a future study team, the development and computation of the various standard requirements would have to be reaccomplished. These costs would be avoided in the marginal approach.

This savings will not be immediately recognized nor without an initial investment. As previously discussed, the proposed standard process would require the development of pre-determined man-hour input-work unit output relationships, based on varying personnel and work center classifications. The expense involved in the collection, assimilation, and analysis of the man-hour-output data will be significant. The necessary information will have to be obtained on a service-wide basis, with each specialty code being structured by grade, experience, and work center size. The resultant output levels would be in units of an appropriate workload factor as previously defined.

Although an arduous task, the development of the pre-determined manuals will result in two additional benefits. The man-hour output relationships will be formulated only once; periodic updating being performed as required. As mentioned, this factor will result in substantial resource savings over the long-range. Subsequent standards will be based on consistent information, not on the specific preferences of different

individuals. In addition, the pre-determined values will serve as guidelines, not directives, for the manpower officer and the work center's supervisory personnel. The manning standard resulting from the marginal approach will be the product of significant input from those who must operate under the standard. As such, the manpower and work center personnel will be allowed to function in an environment of concurrent utilization of the various skills and experiences involved.

Two groups of data must be estimated in order to develop and provide an example of the application of the marginal manning process. First, the output levels of the various grade classifications are quantified. Secondly, the preferred manpower configurations, given increasing ranges of workload, are selected.

These estimations were made with the assistance of the supervisor of the sample work center. Recognizing the differences in personnel experience, education, and background within each grade, the supervisor believed that a credible statement of average output for each grade level could be formulated. Based on his extensive personal experience, the output levels presented are estimated for utilization in this problem.

Table 1. Output Levels

| Grade<br>Level | Average<br>Monthly<br>Output |
|----------------|------------------------------|
| GS-9           | 2900                         |
| GS-7           | 2100                         |
| GS-5           | 1475                         |
| GS-3           | 1000                         |
| GS-1           | 750                          |

As in the manpower standards study presented, the output level is in terms of equivalent workload units. Each employee of the work center does not perform identical work. Therefore, the determination of output is performed on a common basis.

Given this output data, it is possible to develop a preferred manpower table based on a workload range of 26,000 to 42,000 equivalent units. The workload and personnel ranges selected are based on the concurrent considerations of the aforementioned output levels, present workload levels, and current manpower allocation. While the manpower resource constraint is theoretically removed, the total personnel cost, education advancement through on-the-job training, and the opportunity of career progression is also considered. In short, the selection of a specific manpower mix is based on determining the balance of trade-offs between total cost, and the potential for career satisfaction offered in the work center.

The manning configurations presented represent the supervisor's decision concerning the balance of these trade-offs.

The next step is computation of the marginal properties of the manpower range. Using the output table previously estimated as a basis, the manpower marginal product, or the increase in output associated with each increase in grade level, may be calculated. The same procedure for the manpower marginal cost may be undertaken given the monthly salary levels as reported in pay scales. Finally, the marginal cost of the output associated with the various grade classifications is determined. The results of these computations follow.

Table 2. Manning Configurations

| Workload Level | 26,000 | 27,600 | 29,200 | 30,800 | 32,400 | 34,000 | 35,600 | 37,200 | 38,800 | 40,400 | 42,000 |
|----------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| Total People   | 20     | 21     | 22     | 23     | 24     | 25     | 26     | 27     | 28     | 29     | 30     |
| GS-13          | 1      | 1      | 1      | 1      | 1      | 1      | 1      | 1      | 1      | 1      | 1      |
| GS-11          | 2      | 2      | 2      | 2      | 2      | 2      | 2      | 2      | 2      | 2      | 2      |
| GS-9           | 2      | 2      | 2      | 2      | 3      | 3      | 3      | 3      | 3      | 3      | 3      |
| GS-7           | 3      | 3      | 3      | 4      | 4      | 5      | 5      | 5      | 5      | 5      | 5      |
| GS-5           | 7      | 7      | 8      | 8      | 8      | 8      | 9      | 10     | 10     | 10     | 10     |
| GS-3           | 3      | 4      | 4      | 4      | 4      | 4      | 4      | 4      | 5      | 6      | 6      |
| GS-1           | 2      | 2      | 2      | 2      | 2      | 2      | 2      | 2      | 2      | 2      | 3      |

Table 3. Marginal Properties

| Grade | Monthly Salary | Incremental Cost | Monthly Output | Manpower Marginal Product | Manpower Marginal Cost |
|-------|----------------|------------------|----------------|---------------------------|------------------------|
| GS-13 | \$2000         |                  | N/A            |                           |                        |
|       |                | \$581            |                |                           |                        |
| GS-11 | 1419           |                  | N/A            |                           |                        |
|       |                | 242              |                |                           |                        |
| GS-9  | 1177           |                  | 2900           |                           |                        |
|       |                | 213              |                | 800                       | \$0.27                 |
| GS-7  | 964            |                  | 2100           |                           |                        |
|       |                | 185              |                | 625                       | 0.30                   |
| GS-5  | 779            |                  | 1475           |                           |                        |
|       |                | 159              |                | 475                       | 0.33                   |
| GS-3  | 620            |                  | 1000           |                           |                        |
|       |                | 135              |                | 250                       | 0.54                   |
| GS-1  | 485            |                  | 750            |                           |                        |

The manpower level at which an increase in the marginal product does not result in a subsequent decrease in the marginal cost is the manning standard. In this example, the standard would be 24 authorizations, with a manpower mix as specified in the configuration table. The relative simplicity in the development of the standard is due to the assumptions and estimations formed at the outset of the exercise. However, if the assumption of an unlimited manpower resource is relaxed, the determination of a 24 space authorization becomes an intermediate standard. A review and adjustment in the manning table is necessary to reflect the allocation limitation.

Current resources limit the sample work center to 23 spaces. If an additional manning position cannot be awarded the work center as a result of the marginal analysis, and/or if the positions that are authorized cannot be filled with the specified grade levels, the standard must be adjusted to balance the available resource and the resultant output.

The next problem is the determination of the grade mix given those 23 spaces, and the calculation of the workload capability. Given the mix specified by the work center at 20 authorizations, it would seemingly be solved by the addition of three GS-9's. In fact, this approach is justified if based solely on the review of the marginal properties of this grade level. However, when the overall concept of marginal analysis is considered, the consecutive addition of three GS-9's does not follow the requirement of an increase in the marginal product with a corresponding decrease in the marginal cost. These values would simply be constant, while the total personnel cost would rise substan-

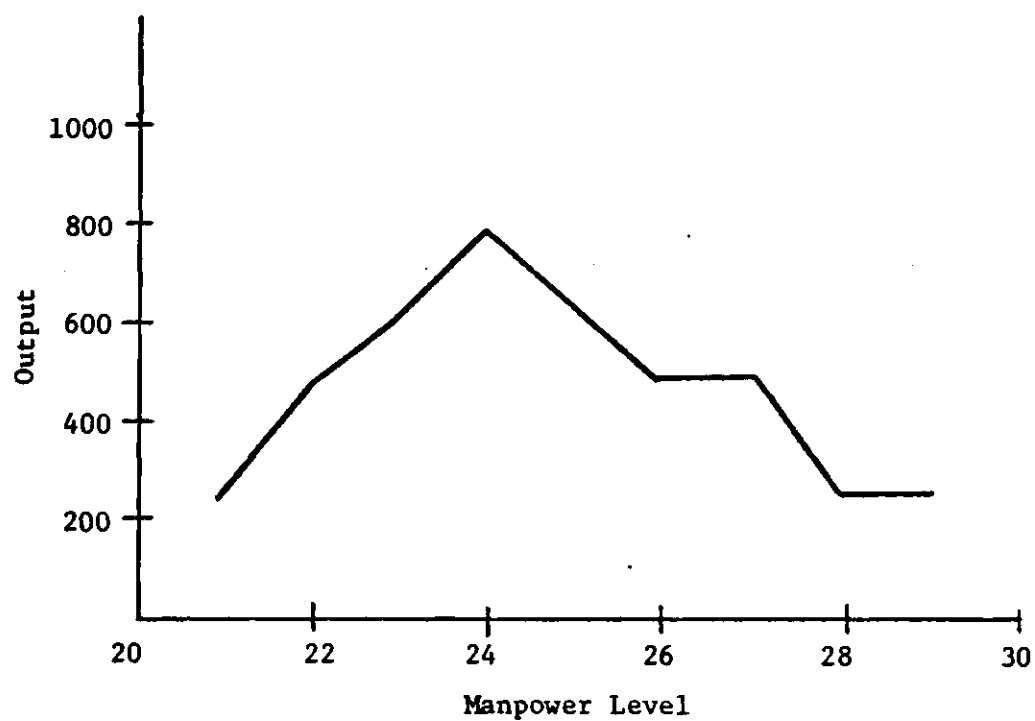


Figure 11. Work Center Marginal Product

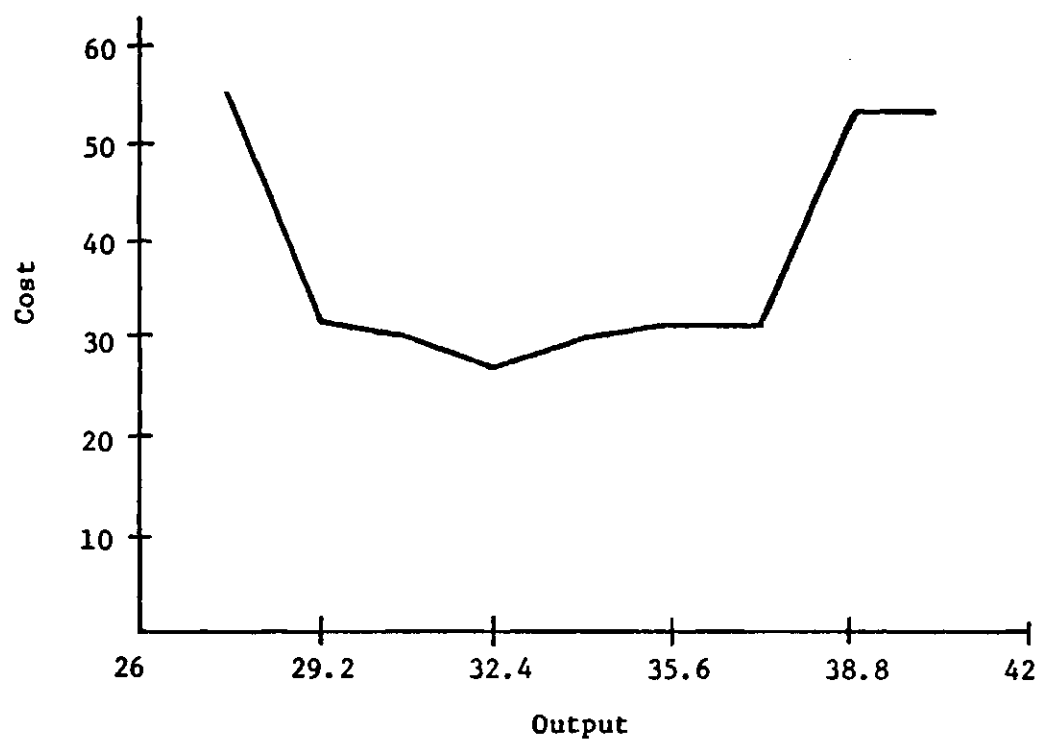


Figure 12. Work Center Marginal Cost



tially.

The determination of the specific manning mix rests on the utilization of the marginal properties previously calculated. Given the resource constraint, marginal analysis would suggest a manpower configuration as follows:

Table 4. Manning Selections

| Workload<br>Level       | 26,000 | 27,600 | 29,200 | 30,800 |
|-------------------------|--------|--------|--------|--------|
| Total<br>Authorizations | 20     | 21     | 22     | 23     |
| GS-13                   | 1      | 1      | 1      | 1      |
| GS-11                   | 2      | 2      | 2      | 2      |
| GS-9                    | 2      | 2      | 2      | 3      |
| GS-7                    | 3      | 3      | 4      | 4      |
| GS-5                    | 7      | 8      | 8      | 8      |
| GS-3                    | 3      | 3      | 3      | 3      |
| GS-1                    | 2      | 2      | 2      | 2      |

The final step of the standard's determination process is computation of the actual work center capability. Until this point in the developmental process, an average workload level has been used. However, the specific personnel grade levels have now been quantified; therefore, an output capability may be expressed. This capability is the average output for each grade level multiplied by the number of personnel in that grade.

Table 5. Work Center Capability

|   |        |        |        |        |
|---|--------|--------|--------|--------|
| Workload<br>Capability<br>(Equivalent<br>Units) | 26,925 | 28,400 | 30,500 | 33,400 |
| Total<br>Authorizations                         | 20     | 21     | 22     | 23     |

The final manpower standard is twenty-three authorizations with a grade mix of:

Table 6. Final Manning Position

|              |                 |
|--------------|-----------------|
| <u>Grade</u> | <u>Quantity</u> |
| GS-13        | 1               |
| GS-11        | 2               |
| GS-9         | 3               |
| GS-7         | 4               |
| GS-5         | 8               |
| GS-3         | 3               |
| GS-1         | 2               |

and a workload capability of 33,400 equivalent units. Workload in excess of this capability level will be deferred or must be reassigned. If future reductions in the manpower authorizations for this work center occur, the manning mix will have to be adjusted, based on the marginal properties involved. The capability will also be recomputed to reflect the decrease in manpower.

## FOOTNOTES FOR CHAPTER VI

1. Appendix B.
2. Appendix F.
3. An opinion held by Colonel Joseph E. Wesp, Commander, Wright-Patterson Air Force Base Medical Center.
4. Department of the Air Force, Air Force Manual 177, Accounting and Finance Manual (27 Vols; Washington, D. C.: Government Printing Office, 1973).

## CHAPTER VII

### ANALYSIS AND CONCLUSIONS

The actual application of marginal analysis to a manpower problem leads to a re-evaluation of the hypothesis presented herein. Present manpower procedures do need to be revised. However, the application of the marginal approach has shown it is not the ultimate solution. The example does reveal the extremely sensitive nature of the marginal process to the data base containing the output and manpower mix information. Had either of the manpower marginal properties followed a reverse trend over the various grade levels, marginal analysis would have been ineffective.

The requirement for specific data trends limits the utility of the proposed approach. Many functions of the Air Force cannot be quantified. For example, headquarters operations, management organizations, or planning functions could not be manned under standard developed through marginal analysis. Therefore, the development of the comprehensive output manuals as previously proposed would be premature.

In a work center conducive to marginal analysis; that is, one whose marginal properties reflect the necessary trends, the marginal approach can be a valuable tool to the manpower manager. The process is economical in terms of a dollar savings in administrative, clerical, and management time. The measurement study could be replaced by an informal analysis of worker production reports to determine the necessary data base. The manning process would reflect interaction between the manpower

officer and work center supervisor. In fact, the supervisor will directly influence the final allocation.

Finally, the resultant standard will be based on the available resource, and will express the capability level of the work center. While limited in its application, marginal analysis can result in an acceptable and realistic standard reflecting the resource and capability constraints involved. The inclusion of these considerations in the manpower process represents a contribution to the field.

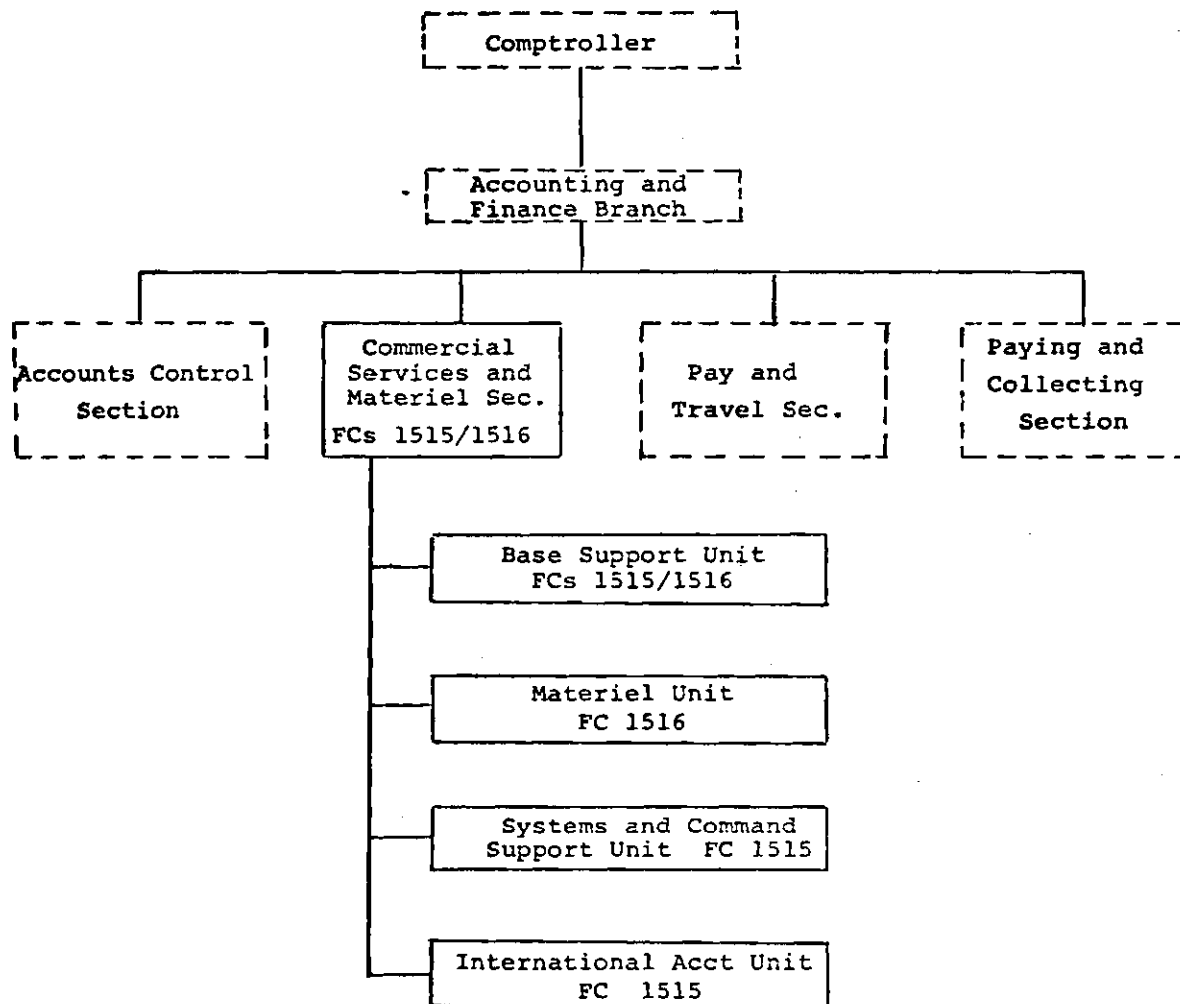
**APPENDIX**

**APPENDIX A**  
**FUNCTIONAL CODE**

**Description of Chart**

Each staff section position under the Accounting and Finance Branch of the Comptroller is assigned a different functional code. In this study FC 1515/1516 was the designator for the Commercial Services and Material Section Office. The line functions were realigned to provide more accurate measurement of the various work centers. The resultant work centers and their assigned functional codes were: The Commercial Services and Materials Section Office, 1515/1516; Base and Tenant Services Accounting, 1515.1; Systems and Receivables Accounting, 1515/2; International Accounting, 1515.3; and Base Stock Funds Accounting, 1515.

## Chart





AFM 25-5

8 August 1973

A16-1

|   |   |
|---|---|
| <b>WORK CENTER<br/>DESCRIPTION</b>  | <b>WORK CENTER TITLE/CODE</b><br><b>APPENDIX B</b><br><b>BASE STOCK FUNDS ACCOUNTING/1516</b> |
| <b>DEFINITION OF RESPONSIBILITIES</b>   |   |
| <b>DIRECT:</b>  |   |
| <p>1. <u>Manually Accomplishes Accounting for the Commissary Division, Air Force Stock Funds (AFSF):</u> Processes commissary receiving reports, issues/charge sales and turn-ins, commissary cash receipts and disbursements, and surcharge liability transactions. Verifies each line item for quantity, unit cost, nomenclature, and extended value. Receives and reviews purchase order (PO) and blanket purchase agreement (BPA) data. Identifies discount offers. Manually prepares commissary records. Processes commercial invoices and interfund billings. Prepares, controls, and distributes payment vouchers. Liquidates accounts payable and establishes received-not-billed records. Performs follow-up as required. Codes, inputs, and edits input data to the UNIVAC 1050-II system. Files, distributes, and transmits 1050-II output data to the B-3500 computer. Edits and files B-3500 output and forwards completed products to Accounts Control. Monitors dishonored/redeemed checks. Prepares journal vouchers, monthly trial balance, and all commissary related accounting reports.</p> |   |
| <p>2. <u>Accomplishes Accounting for the General Support and Systems Support Divisions, AFSF:</u> Receives, reviews, and corrects computerized listings. Receives and reviews PO and BPA data. Identifies discount offers. Verifies each line item for quantity, unit cost, nomenclature, and extended value. Manually prepares general support and systems support records. Processes commercial invoices and interfund billings. Prepares, controls, and distributes payment vouchers. Liquidates accounts payable and establishes received-not-billed records. Verifies the general ledger account update. Establishes or deletes customer accounts. Performs follow-up as required. Codes, inputs, and edits input data to the UNIVAC 1050-II system. Files, distributes, and transmits 1050-II output data to the B-3500 computer. Edits and files B-3500 output and forwards completed products to Accounts Control. Prepares journal vouchers, monthly trial balance, and all accounting reports related to the General Support and Systems Support Divisions, AFSF.</p>                                 |   |
| <p>3. <u>Accomplishes Accounting for the Medical-Dental Division, AFSF:</u> Receives and reviews PO and BPA data. Identifies discount offers. Verifies each line item for quantity, unit cost, nomenclature, and extended value. Manually prepares medical-dental records. Processes commercial invoices and interfund billings. Prepares, controls, and distributes payment vouchers. Liquidates accounts payable and establishes received-not-billed records. Codes, inputs, and edits input data to the B-3500 computer. Maintains control over cash disbursements. Revises, deletes, or establishes customer accounts. Analyzes and resolves inventory</p>  |   |

## APPENDIX B

## BASE STOCK FUNDS ACCOUNTING/1516

discrepancies. Performs follow-up as required. Edits and files B-3500 output and forwards completed products to Accounts Control. Prepares journal vouchers, monthly trial balance, and all accounting reports related to the Medical-Dental Division, AFSF.

4. Accomplishes Accounting for the Fuels Division, AFSF:  
Processes Fuels Issue/Defuel Documents. Manually prepares fuels records. Receives, reviews, and corrects computerized listings. Inputs transaction data into the UNIVAC 1050-II system. Processes commercial invoices and interfund billings. Prepares, controls, and distributes payment vouchers. Liquidates accounts payable and establishes received-not-billed records. Inputs billing data into the B-3500 system. Verifies the general ledger account update. Prepares journal vouchers, monthly trial balance, and all accounting reports related to the Fuels Division, AFSF.

5. Accomplishes Accounting for the Clothing Division, AFSF:  
Processes inventory transaction data and inputs data into the UNIVAC 1050-II system. Manually prepares clothing accounting records. Updates the AFSF General Ledger and the ACF General fund billings. Prepares, controls, and distributes payment vouchers. Liquidates accounts payable and establishes received-not-billed records. Inputs billing data into the B-3500 system. Monitors dishonored/redeemed checks. Prepares journal vouchers, monthly trial balance, and all accounting reports related to the Clothing Division, AFSF.

6. Manually Accomplishes Accounting for the Chaplain Fund Division, AFSF: Manually records all transactions affecting the Chaplain Fund. Verifies each line item for quantity, unit cost, nomenclature, and extended value. Manually prepares chaplain fund accounting records. Prepares journal vouchers, monthly trial balance, and all accounting reports related to the Chaplain Fund Division, AFSF.

7. Accomplishes Accounting for Ground Fuels: Petroleum, Oil, and Lubricants (POL): Processes billing cards. Prepares all accounting reports related to ground fuels.

8. Monitors Reports of Survey: Monitors inventory adjustments requiring reports of survey.

**APPENDIX B****BASE STOCK FUNDS ACCOUNTING/1516****INDIRECT:**

**19. Supervision:** Administers and supervises personnel, reviews incoming and outgoing distribution, reviews reports and statistical data, coordinates, and receives and assists visiting officials.

**110. Administration:** Types communications, processes incoming and outgoing distribution, maintains unclassified correspondence, operates duplicating machines, maintains stocks of blank forms, maintains status charts, maintains time and attendance cards, acknowledges visitors, and initiates and receives telephone calls.

**111. Meetings:** Prepares for, conducts, or attend meetings, briefings, and conferences.

**112. Training:** Monitors training, develops training material, conducts and receives training, and maintains training records.

**113. Supply:** Obtains expendable supplies.

**114. Cleanup:** Prepares work area, puts work away, cleans work area, and maintains building grounds.

## APPENDIX C

| II. COMPUTATIONS     |  |                                  |                                 |               |               |         |
|----------------------|--|----------------------------------|---------------------------------|---------------|---------------|---------|
| CATEGORY<br>A.       | NUMBER<br>OF<br>SAMPLES<br>B.  | PERCENT<br>OCCURRENCE<br>P<br>C. | TIME                            |               |               |         |
|                      |  |                                  | MEASURED<br>D.                  | LEVELED<br>E. | ALLOWED<br>F. |         |
| DIRECT<br>PRODUCTIVE | 1. Manually Accomplishes Accounting for the Commissary Division, AFSF                  | 1109                             | .181                            | 555.41        | 549.57        | 613.32  |
|                      | 2. Accomplishes Accounting for the General Support and Systems Support Divisions, AFSF | 2561                             | .418                            | 1282.59       | 1269.12       | 1416.34 |
|                      | 3. Accomplishes Accounting for the Medical-Dental Division, AFSF                       | 626                              | .102                            | 313.51        | 310.22        | 346.20  |
|                      | 4. Accomplishes Accounting for the Fuels Division, AFSF                                | 157                              | .026                            | 78.63         | 77.80         | 86.83   |
|                      | 5. Accomplishes Accounting for the Clothing Division, AFSF                             | 134                              | .022                            | 67.11         | 66.40         | 74.11   |
|                      | 6. Manually Accomplishes Accounting for the Chaplain Fund Division, AFSF               | 19                               | .003                            | 9.52          | 9.42          | 10.51   |
|                      | 7. Accomplishes Accounting for Ground Fuels: POL                                       | 1                                | .000                            | .50           | .50           | .55     |
|                      | 8. Monitors Reports of Survey  | 54                               | .009                            | 27.04         | 26.76         | 29.86   |
| INDIRECT             | 19. Supervision  | 42                               | .007                            | 21.02         | 20.81         | 23.23   |
|                      | 110. Administration  | 138                              | .023                            | 69.11         | 68.39         | 76.32   |
|                      | 111. Meetings  | 29                               | .005                            | 14.52         | 14.37         | 16.04   |
|                      | 112. Training  | 114                              | .019                            | 57.09         | 56.49         | 63.05   |
|                      | 113. Supply  | 1                                | .005                            | 15.02         | 14.87         | 16.59   |
| OTHER                | TOTAL PRODUCTIVE   | 5015                             | .819                            | 2511.59       | 2485.22       | 2773.51 |
|                      | NONAVAILABLE   | 507                              | .083                            | 253.91        |               |         |
|                      | UNAVOIDABLE DELAY  | 0                                | 0                               | 0             |               |         |
|                      | PERSONAL/REST  | 207                              | .034                            | 103.67        |               |         |
|                      | IDLE   | 397                              | .065                            | 198.82        |               |         |
|                      |  |                                  |                                 |               |               |         |
|                      | TOTAL  | N = 6126                         | 1.000                           | 3068.00       |               |         |
|                      | SAMPLES REQUIRED   | N' = 1081                        | ABSOLUTE ACCURACY FOR LARGEST P |               |               | .0126   |

| STANDARD INPUT<br>DATA COMPUTATION  |                        |  |                           | COMMAND, LOCATION, ORGANIZATIONAL LEVEL<br>AFLC, WPAFB, WING |                              | DATE<br>31 Dec 74          |  |
|---|------------------------|--|---------------------------|--|------------------------------|----------------------------|--|
| FUNCTION<br>Comptroller   |                        | SUBFUNCTION/ CODE<br>Materiel Acct<br>and Finance/1516 |                           | WORK CENTER/CODE<br>Base Stock Funds Acct/1516               |                              |                            |  |
| PRODUCTIVE<br>CATEGORIES<br>A.  | ALLOWED TIME FROM      |  | SUBTOTAL<br>(B + C)<br>D. | MONTHLY<br>ADJUSTED<br>ALLOWED<br>TIME<br>(1.050 x D)<br>E.  | MONTHLY ALLOWED<br>TIME FROM |                            | TOTAL<br>MONTHLY<br>ALLOWED<br>TIME<br>(E + F + G)<br>H. |
|   | WORK<br>SAMPLING<br>B. | OVERTIME<br>C.   |                           |  | TIME<br>STUDY<br>F.          | OPERATIONAL<br>AUDIT<br>G. |  |
| DIRECT:   |                        |  |                           |  |                              |                            |  |
| 1. Manually accomplishes accounting for the Commissary Division, AFSF                 | 613.32                 |  | 613.32                    | 643.99   |                              | 198.36                     | 842.35   |
| 2. Accomplishes accounting for the General Support and Systems Support Division, AFSF | 1416.34                |  | 1416.34                   | 1487.16  |                              | 81.27                      | 1568.43  |
| 3. Accomplishes accounting for the Medical-Dental Division, AFSF                      | 346.20                 |  | 346.20                    | 363.51   |                              | 20.83                      | 384.34   |
| 4. Accomplishes accounting for the Fuels Division, AFSF                               | 86.83                  |  | 86.83                     | 91.17  |                              | 3.20                       | 94.37  |
| 5. Accomplishes accounting for the Clothing Div, AFSF                                 | 74.11                  |  | 74.11                     | 77.82  |                              | 3.52                       | 81.34  |
| TOTALS  |                        |  |                           |  |                              |                            | continued  |
| PROPOSED AFSC DISTRIBUTION  |                        |  |                           | MANPOWER REQUIRED<br>(Total Monthly Allowed ÷ 140)           |                              |                            |  |
| AFSC  |                        |  | NUMBER                    | REMARKS  |                              |                            |  |
|   |                        |  |                           |  |                              |                            |  |
| TOTAL   |                        |  |                           |  |                              |                            |  |
| 1. Adjustment Factor  |                        |  |                           |  |                              |                            |  |

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APPENDIX D

| STANDARD INPUT<br>DATA COMPUTATION                                       |                        |   |                           | COMMAND, LOCATION, ORGANIZATIONAL LEVEL<br>AFLC, WPAFB, WING           |                              | DATE<br>31 Dec 74          |  |
|--|------------------------|---|---------------------------|--|------------------------------|----------------------------|--|
| FUNCTION<br>Comptroller  |                        | SUBFUNCTION/CODE<br>Materiel Acct<br>and Finance/1516 |                           | WORK CENTER/CODE<br>Base Stock Funds Acct/1516                         |                              |                            |  |
| PRODUCTIVE<br>CATEGORIES<br>A.   | ALLOWED TIME FROM      |   | SUBTOTAL<br>(B + C)<br>D. | MONTHLY<br>ADJUSTED<br>ALLOWED<br>TIME<br>$E. = .050^1 \times D$<br>E. | MONTHLY ALLOWED<br>TIME FROM |                            | TOTAL<br>MONTHLY<br>ALLOWED<br>TIME<br>(E + F + G)<br>H. |
|  | WORK<br>SAMPLING<br>B. | OVERTIME<br>C.  |                           |  | TIME<br>STUDY<br>F.          | OPERATIONAL<br>AUDIT<br>G. |  |
| 6. Manually accomplishes accounting for the Chaplain Fund Division, AFSC | 10.51                  |   | 10.51                     | 11.04  |                              | .44                        | 11.48  |
| 7. Accomplishes accounting for Ground Fuels: (POL)                       | .55                    |   | .55                       | .58  |                              | 2.64                       | 3.22   |
| 8. Monitors Reports of Survey  | 29.86                  |   | 29.86                     | 31.35  |                              |                            | 31.35  |
| TOTAL DIRECT   | 2577.72                |   | 2577.72                   | 2706.62  |                              | 310.26                     | 3016.88  |
| INDIRECT:  |                        |   |                           |  |                              |                            |  |
| I9. Supervision  | 23.23                  |   | 23.23                     | 24.39  |                              | 2.79                       | 27.18  |
| I10. Administration  | 76.32                  |   | 76.32                     | 80.14  |                              | 13.97                      | 94.11  |
| I11. Meetings  | 16.04                  |   | 16.04                     | 16.84  |                              |                            | 16.84  |
| TOTALS   |                        |   |                           |  |                              |                            | continued  |
| PROPOSED AFSC DISTRIBUTION   |                        |   |                           | MANPOWER REQUIRED<br>(Total Monthly Allowed $\div$ 140)                |                              |                            |  |
| AFSC   |                        |   | NUMBER                    | REMARKS  |                              |                            |  |
|  |                        |   |                           |  |                              |                            |  |
| TOTAL  |                        |   |                           |  |                              |                            |  |
| 1. Adjustment Factor   |                        |   |                           |  |                              |                            |  |

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APPENDIX D

| STANDARD INPUT<br>DATA COMPUTATION           |  |   |  | COMMAND, LOCATION, ORGANIZATIONAL LEVEL               |                           |  | DATE   |
|--|--|---|--|---|---------------------------|--|--|
| FUNCTION<br>Comptroller                      |  |   |  | SUBFUNCTION/CODE<br>Materiel Acct<br>and Finance/1516 |                           | WORK CENTER/CODE<br>Base Stock Funds Acct/1516             |  |
| PRODUCTIVE<br>CATEGORIES<br>A.               |  | ALLOWED TIME FROM<br>WORK<br>SAMPLING<br>B. |  | OVERTIME<br>C.  | SUBTOTAL<br>(B + C)<br>D. | MONTHLY<br>ADJUSTED<br>ALLOWED<br>TIME<br>(1.05 x D)<br>E. | MONTHLY ALLOWED<br>TIME FROM<br>TIME<br>STUDY<br>F.      |
|  |  |   |  |   |                           |  | OPERATIONAL<br>AUDIT<br>G.                               |
|  |  |   |  |   |                           |  | TOTAL<br>MONTHLY<br>ALLOWED<br>TIME<br>(E + F + G)<br>H. |
| I12. Training                                |  | 63.05                                       |  |   | 63.05                     | 66.20  |  |
| I13. Supply                                  |  | .55   |  |   | .55                       | .58  |  |
| I14. Cleanup                                 |  | 16.59                                       |  |   | 16.59                     | 17.42  |  |
| TOTAL INDIRECT                               |  | 195.78                                      |  |   | 195.78                    | 205.57   | 16.76  |
|  |  |   |  |   |                           |  | 222.33   |
| TOTALS                                       |  | 2773.51                                     |  |   | 2773.51                   | 2912.19  | 327.02   |
| PROPOSED AFSC DISTRIBUTION                   |  |   |  |   |                           |  | 3239.21  |
| AFSC   |  |   |  |   | NUMBER                    | MANPOWER REQUIRED<br>(Total Monthly Allowed ÷ 140)         |  |
| Acct & Fin Off 6724                          |  | CIV   |  |   |                           | 22.495   |  |
| Acct & Fin Supt 67290                        |  | CIV   |  |   |                           |  |  |
| Acct & Fin Supvr 67170                       |  | CIV   |  |   |                           |  |  |
| Gen Acct Spec 67151                          |  | CIV   |  |   |                           |  |  |
| Gen Acct Spec 67131                          |  | CIV   |  |   |                           |  |  |
| Admin Spec 70250                             |  | CIV   |  |   |                           |  |  |
| TOTAL  |  |   |  |   | 22.495                    |  |  |
| 1. Adjustment Factor $20.99 \div 20 = 1.050$ |  |   |  |   |                           |  |  |

APPENDIX D

| OPERATIONAL AUDIT<br>DATA  | COMMAND, LOCATION, ORGANIZATION LEVEL<br><br>AFLC<br>WPAFB<br>WING |                            | FUNCTION, SUBFUNCTION/CODE, WORK CENTER/CODE<br>Comptroller<br>Materiel Acct & Fin/1516<br>Base Stock Funds Acct/1516 |                               | COMPLETION DATE<br>31 Dec 74 |                               |             |
|--|--|----------------------------|---|-------------------------------|------------------------------|-------------------------------|-------------|
|  |  |                            |   |                               | PAGE<br>1                    |                               |             |
| ACTIVITY TITLE<br>A  | NO.<br>PERS<br>RQD<br>B  | ACTIVITY<br>FREQUENCY<br>C | FREQUENCY   |                               | ALLOWED MANHOURS             |                               | TOTALS<br>H |
|  |  |                            | CONVERSION<br>FACTOR<br>D   | PER MONTH<br>(C X D = E)<br>E | PER<br>ACCOMPLISHMENT<br>F   | PER MONTH<br>(E X F = G)<br>G |             |
| DIRECT:  |  |                            |   |                               |                              |                               |             |
| 1. Manually accomplishes accounting for the Commissary Division, AFSF  |  |                            |   |                               |                              |                               |             |
| a. Processes Commissary disbursements and commercial invoices  |  |                            |   |                               |                              |                               |             |
| (1) Records and totals commercial vouchers in voucher register   |  | 3/MO                       | 1.00  | 3.00                          | 13.00                        | 39.00                         |             |
| (2) Balances totals with Commissary personnel  |  | 1/MO                       | 1.00  | 1.00                          | 2.00                         | 2.00                          |             |
| (3) Records disbursement vouchers in disbursement ledger   |  | 3/MO                       | 1.00  | 3.00                          | 8.00                         | 24.00                         |             |
| (4) Records vouchers and disbursements in accounts payable ledger  |  | 3/MO                       | 1.00  | 3.00                          | 8.00                         | 24.00                         |             |
| b. Verifies each line item for quantity, unit cost, nomenclature, and extended value                                   |  | 484/MO                     | 1.00  | 484.00                        | .02                          | 9.68                          |             |
| c. Manually prepares Commissary records  |  | 1/YR                       | .08   | .08                           | 38.00                        | 3.04                          |             |
| d. Processes interfund billings  |  |                            |   |                               |                              |                               |             |
| (1) Records DSA vouchers in DSA ledger   |  | 1/MO                       | 1.00  | 1.00                          | 1.00                         | 1.00                          |             |
| (2) Verifies DSA computerized billing list against receipts  |  | 1/MO                       | 1.00  | 1.00                          | 24.00                        | 24.00                         |             |
| e. Liquidates accounts payable and establishes received-not-billed records   |  |                            |   |                               |                              |                               |             |
| (1) Reconciles received-not-billed quantities with paying clerks, correspondence received, and company representatives |  | 17d1                       | 20.99   | 20.99                         | 1.00                         | 20.99                         |             |

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APPENDIX E



| OPERATIONAL AUDIT<br>DATA   | COMMAND, LOCATION, ORGANIZATION LEVEL |                            | FUNCTION, SUBFUNCTION/CODE, WORK CENTER/CODE                          |                               | COMPLETION DATE            |                               |             |
|---|---------------------------------------|----------------------------|---|-------------------------------|----------------------------|-------------------------------|-------------|
|   | AFLC<br>WPAFB<br>WING                 |                            | Comptroller<br>Materiel Acct & Fin/1516<br>Base Stock Funds Acct/1516 |                               | 31 Dec 74<br>PAGE 2        |                               |             |
| ACTIVITY TITLE<br>A   | NO.<br>PERS<br>RQD<br>B               | ACTIVITY<br>FREQUENCY<br>C | FREQUENCY   |                               | ALLOWED MANHOURS           |                               | TOTALS<br>H |
|   |                                       |                            | CONVERSION<br>FACTOR<br>D   | PER MONTH<br>(C X D = E)<br>E | PER<br>ACCOMPLISHMENT<br>F | PER MONTH<br>(E X F = G)<br>G |             |
| f. Follow-ups as required   |                                       |                            |   |                               |                            |                               |             |
| (1) Prepares aging sheet showing month the receiving report was obtained                          |                                       | 1/MO                       | 1.00  | 1.00                          | 4.00                       | 4.00                          |             |
| (2) Initiates and/or investigates follow-up action in progress                                    |                                       | 104/MO                     | 1.00  | 104.00                        | .25                        | 26.00                         |             |
| g. Prepares journal voucher, monthly trial balance, and all commissary related accounting reports |                                       |                            |   |                               |                            |                               |             |
| (1) Prepares journal vouchers   |                                       | 1/MO                       | 1.00  | 1.00                          | 3.00                       | 3.00                          |             |
| (2) Prepares monthly trial balance  |                                       |                            |   |                               |                            |                               |             |
| (a) Balances disbursement ledger total with the mechanized accounting and finance report (MAFR)   |                                       | 1/MO                       | 1.00  | 1.00                          | .17                        | .17                           |             |
| (b) Balances accounts payable ledger with general ledger total                                    |                                       | 1/MO                       | 1.00  | 1.00                          | 12.00                      | 12.00                         |             |
| (c) Prepares worksheet of accounts payable ledger to accompany trial balance                      |                                       | 1/MO                       | 1.00  | 1.00                          | 4.00                       | 4.00                          |             |
| (3) Prepares all Commissary related accounting reports  |                                       |                            |   |                               |                            |                               |             |
| (a) Prepares DSA report of undelivered delivery orders outstanding for general ledger report      |                                       | 1/MO                       | 1.00  | 1.00                          | 1.00                       | 1.00                          |             |
| (b) Prepares RCS:HAF-ACF(A) 7194 (INPUT)  |                                       | 2/YR                       | .08   | .16                           | 2.00                       | .32                           |             |
| (c) Prepares certificate of gains, losses, and discrepancies                                      |                                       | 2/YR                       | .08   | .16                           | 1.00                       | .16                           |             |

| OPERATIONAL AUDIT<br>DATA  | COMMAND, LOCATION, ORGANIZATION LEVEL<br>AFLC<br>WPAFB<br>WING |                            | FUNCTION, SUBFUNCTION/CODE, WORK CENTER/CODE<br>Comptroller<br>Materiel Acct & Fin/1516<br>Base Stock Funds Acct/1516 |                               | COMPLETION DATE<br>31 Dec 74 |                               |             |
|--|--|----------------------------|---|-------------------------------|------------------------------|-------------------------------|-------------|
|  |  |                            |   |                               | PAGE<br>3                    |                               |             |
| ACTIVITY TITLE<br>A  | NO.<br>PERS<br>RQD<br>B  | ACTIVITY<br>FREQUENCY<br>C | FREQUENCY   |                               | ALLOWED MANHOURS             |                               |             |
|  |  |                            | CONVERSION<br>FACTOR<br>D   | PER MONTH<br>(C X D = E)<br>E | PER<br>ACCOMPLISHMENT<br>F   | PER MONTH<br>(E X F = G)<br>G | TOTALS<br>H |
| 2. Accomplishes accounting for the General Support and Systems Support Divisions, AFSF   |  |                            |   |                               |                              |                               |             |
| a. Verifies each line item for quantity, unit cost, nomenclature, and extended value   |  | 902/MO                     | 1.00  | 902.00                        | .02                          | 18.04                         |             |
| b. Manually prepares General Support and Systems Support accounting records  |  | 1/YR                       | .08   | .08                           | 173.00                       | 13.84                         |             |
| c. Performs follow-ups as required<br>(1) Initiates and/or investigates follow-up action in progress   |  | 195/MO                     | 1.00  | 195.00                        | .25                          | 48.75                         |             |
| d. Prepares all accounting reports related to the General Support and Systems Support Divisions, AFSF<br>(1) Prepares DD-COMP(A) 875 Report<br>(2) Prepares input to joint tenant reimbursable and nonreimbursable support |  | 1/YR                       | .08   | .08                           | 4.00                         | .32                           |             |
|  |  | 2/YR                       | .08   | .16                           | 2.00                         | .32                           |             |
|  |  |                            |   |                               | Category                     | Man-hour                      | Total 81.27 |
| 3. Accomplishes accounting for the Medical-Dental Division, AFSF   |  |                            |   |                               |                              |                               |             |
| a. Verifies each line item for quantity, unit cost, nomenclature, and extended value   |  | 221/MO                     | 1.00  | 221.00                        | .02                          | 4.42                          |             |
| b. Manually prepares Medical-Dental accounting records   |  | 1/YR                       | .08   | .08                           | 52.00                        | 4.16                          |             |

| OPERATIONAL AUDIT<br>DATA  | COMMAND, LOCATION, ORGANIZATION LEVEL<br>AFLC<br>WPAPB<br>WING |                            | FUNCTION, SUBFUNCTION/CODE, WORK CENTER/CODE<br>Comptroller<br>Materiel Acct & Fin/1516<br>Base Stock Fund Acct/1516 |                               | COMPLETION DATE<br>31 Dec 74 |                               |             |
|--|--|----------------------------|--|-------------------------------|------------------------------|-------------------------------|-------------|
|  |  |                            |  |                               | PAGE<br>4                    |                               |             |
| ACTIVITY TITLE<br>A  | NO.<br>PERS<br>RQRD<br>B                                       | ACTIVITY<br>FREQUENCY<br>C | FREQUENCY  |                               | ALLOWED MANHOURS             |                               | TOTALS<br>H |
|  |  |                            | CONVERSION<br>FACTOR<br>D  | PER MONTH<br>(C X D = E)<br>E | PER<br>ACCOMPLISHMENT<br>F   | PER MONTH<br>(E X F = G)<br>G |             |
| c. Performs follow-up as required<br>(1) Initiates and/or investigates<br>follow-up action in progress |  | 49/MO                      | 1.00   | 49.00                         | .25                          | 12.25                         |             |
|  |  |                            |  |                               | Category Man-hour Total      |                               | 20.83       |
| 4. Accomplishes accounting for the Fuels<br>Division, AFSF   |  | 1/YR                       | .08  | 40.00                         | 3.20                         |                               |             |
| a. Manually prepares fuels accounting<br>records   |  |                            |  |                               | Category Man-hour Total      |                               | 3.20        |
| 5. Accomplishes accounting for the Cloth-<br>ing Division, AFSF  |  | 1/YR                       | .08  | .08                           | 44.00                        | 3.52                          |             |
| a. Manually prepares clothing account-<br>ing records  |  |                            |  |                               | Category Man-hour Total      |                               | 3.52        |
| 6. Manually accomplishes accounting<br>for the Chaplin Fund Division, AFSF                             |  | 6/MO                       | 1.00   | 5.00                          | .02                          | .12                           |             |
| a. Verifies each line item for quan-<br>tity, unit cost, nomenclature,<br>and extended value           |  |                            |  |                               |                              |                               |             |
| b. Manually records all transactions'<br>affecting the Chaplin fund                                    |  | 1.YR                       | .08  | .08                           | 4.00                         | .32                           |             |
| (1) Manually prepares Chaplin fund<br>accounting records   |  |                            |  |                               | Category Man-hour Total      |                               | .44         |
| 7. Accomplishes accounting for Ground<br>Fuels: Petroleum, Oil, and Lubricants<br>(POL)                |  |                            |  |                               |                              |                               |             |

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APPENDIX E

| OPERATIONAL AUDIT<br>DATA                                 | COMMAND, LOCATION, ORGANIZATION LEVEL<br><br>AFLC<br>WPAFB<br>WING |                            | FUNCTION, SUBFUNCTION/CODE, WORK CENTER/CODE<br><br>Comptroller<br>Materiel Acct & Fin/1516<br>Base Stock Funds Acct/1516 |                               | COMPLETION DATE            |                               |             |
|---|--|----------------------------|---|-------------------------------|----------------------------|-------------------------------|-------------|
|   |  |                            |   |                               | 31 Dec 74                  |                               |             |
|   |  |                            |   |                               | PAGE                       |                               |             |
|   |  |                            |   |                               | 5                          |                               |             |
| ACTIVITY TITLE<br>A                                       | NO.<br>PERS<br>RQD<br>B  | ACTIVITY<br>FREQUENCY<br>C | FREQUENCY   |                               | ALLOWED MANHOURS           |                               | TOTALS<br>H |
|   |  |                            | CONVERSION<br>FACTOR<br>D   | PER MONTH<br>(C X D = E)<br>E | PER<br>ACCOMPLISHMENT<br>F | PER MONTH<br>(E X F = G)<br>G |             |
| a. Processes billing cards                                |  | 1/QT                       | .33   | .33                           | 8.00                       | 2.64                          |             |
| INDIRECT  |  |                            |   |                               | Category Man-hour Total    |                               | 2.64        |
| I9. Supervision   |  |                            |   |                               | Direct Man-hour Total      |                               | 310.26      |
| a. Administers personnel                                  |  |                            |   |                               |                            |                               |             |
| (1) Rates performance of permanent employees              |  |                            |   |                               |                            |                               |             |
| (a) Counsels personnel                                    |  | 1/YR                       | .08   | .08                           | 15.00                      | 1.20                          |             |
| (b) Prepares performance reports                          |  | 1/YR                       | .08   | .08                           | 7.50                       | .60                           |             |
| (2) Rates Worker Training Opportunity Program employees   |  | 1/QT                       | .33   | .33                           | 2.00                       | .66                           |             |
| (a) Counsels personnel                                    |  |                            |   |                               |                            |                               |             |
| (b) Prepares performance reports                          |  | 1/QT                       | .33   | .33                           | 1.00                       | .33                           |             |
|   |  |                            |   |                               | Category Man-hour Total    |                               | 2.79        |
| I10. Administration                                       |  |                            |   |                               |                            |                               |             |
| a. Maintains unclassified correspondence files            |  |                            |   |                               |                            |                               |             |
| (1) Destroys records                                      |  |                            |   |                               |                            |                               |             |
| (a) Prepares and boxes listings and documents for storage |  | 1/YR                       | .08   | .08                           | 88.00                      | 7.04                          |             |
| (b) Processes incoming and outgoing distribution          |  | 1/DL                       | 20.99   | 20.99                         | .33                        | 6.93                          |             |
|   |  |                            |   |                               | Category Man-hour Total    |                               | 13.97       |
|   |  |                            |   |                               | Indirect Man-hour Total    |                               | 16.76       |

|                           |  |                            |   |                               |                              |                               |             |
|---------------------------|--|----------------------------|---|-------------------------------|------------------------------|-------------------------------|-------------|
| OPERATIONAL AUDIT<br>DATA | COMMAND, LOCATION, ORGANIZATION LEVEL<br>AFLC<br>WPAFB<br>WING |                            | FUNCTION, SUBFUNCTION/CODE, WORK CENTER/CODE<br>Comptroller<br>Materiel Acct & Fin/1516<br>Base Stock Funds Acct/1516 |                               | COMPLETION DATE<br>31 Dec 74 |                               |             |
|                           |  |                            |   |                               | PAGE<br>6                    |                               |             |
| ACTIVITY TITLE<br>A       | NO.<br>PERS<br>RQD<br>B  | ACTIVITY<br>FREQUENCY<br>C | FREQUENCY   |                               | ALLOWED MANHOURS             |                               |             |
|                           |  |                            | CONVERSION<br>FACTOR<br>D   | PER MONTH<br>(C X D = E)<br>E | PER<br>ACCOMPLISHMENT<br>F   | PER MONTH<br>(E X F = G)<br>G | TOTALS<br>H |
|                           |  | Activity                   | Manhours<br>Standard  |                               | Direct<br>310.26             | Indirect<br>16.76             | 327.02      |

APPENDIX E

1. Segregation of Measured Man-hours:

| Category | Allowed<br>Man-hours | Fixed<br>Percent | Fixed<br>Man-hours | Variable<br>Percent | Variable<br>Man-hours | Personnel<br>Percent | Generated<br>Man-hours |
|----------|----------------------|------------------|--------------------|---------------------|-----------------------|----------------------|------------------------|
| 1        | 842.35               |                  |                    | 1.00                | 842.35                |                      |                        |
| 2        | 1,568.43             |                  |                    | 1.00                | 1,568.43              |                      |                        |
| 3        | 384.34               |                  |                    | 1.00                | 384.34                |                      |                        |
| 4        | 94.37                |                  |                    | 1.00                | 94.37                 |                      |                        |
| 5        | 81.34                |                  |                    | 1.00                | 81.34                 |                      |                        |
| 6        | 11.48                |                  |                    | 1.00                | 11.48                 |                      |                        |
| 7        | 3.22                 |                  |                    | 1.00                | 3.22                  |                      |                        |
| 8        | 31.35                |                  |                    | 1.00                | 31.35                 |                      |                        |
| 9        | 27.18                | .90              | 24.46              |                     |                       | .10                  | 2.72                   |
| 10       | 94.11                | .79              | 74.35              | .13                 | 12.23                 | .08                  | 7.53                   |
| 11       | 16.84                |                  |                    |                     |                       | 1.00                 | 16.84                  |
| 12       | 66.20                |                  |                    |                     |                       | 1.00                 | 66.20                  |
| 13       | .58                  | .10              | .06                |                     |                       | .90                  | .52                    |
| 14       | 17.42                |                  |                    |                     |                       | 1.00                 | 17.42                  |
| TOTALS   | 3,239.21             |                  |                    |                     | 3,029.11              |                      | 111.23                 |

STANDARD MANPOWER EQUATION

APPENDIX F

**APPENDIX F**  
**STANDARD MANPOWER EQUATION**

**2. Development of Standard Equation:**

**a. Factor Development:**

$$F = 1 + \frac{\text{Personnel Generated Man-hours}}{\text{Fixed Man-hours} + \text{Variable Man-hours}}$$

$$F = 1 + \frac{111.23}{98.87 + 3,029.11}$$

$$F = 1 + .036$$

$$F = 1.036$$

**b. Equation Development:**

$$Y = F \left( \text{Fixed Man-hours} + \frac{\text{Variable Man-hours}}{\text{Monthly Workload Factor}} X \right)$$

$$Y = 1.036 \left( 98.87 + \frac{3,029.11}{29,728.65} X \right)$$

$$Y = 1.036(98.87 + .1019X)$$

$$Y = 102.43 + .1056X$$

**3. Computation of Workload Breakpoints:**

**a. Conversion of Equation to Manpower Spaces:**

$$Y = \frac{102.43 + .1056X}{144}$$

$$Y = .7113 + .0007333X$$

**b. Computation of Lower and Upper Workload Extrapolation Limits:**

$$X_{\min} = 25,269$$

$$Y_{\min} = .7113 + .0007333(25,269)$$

$$Y_{\min} = 19.24 \text{ or } 20 \text{ spaces}$$

$$X_{\max} = 34,188$$

$$Y_{\max} = .7113 + .0007333(34,188)$$

$$Y_{\max} = 25.78 \text{ or } 26 \text{ spaces}$$

APPENDIX F  
STANDARD MANPOWER EQUATION

- c. Computation of the minimum and maximum extrapolated values determines a range between 20 and 26 spaces ( $23 \pm 3$ ).
- d. Computation of Workload Breakpoint:

$$x = \frac{y - .7113}{.0007333}$$

$$x_1 = \frac{20 - .7113}{.0007333}$$

$$x_2 = \frac{21 - .7113}{.0007333}$$

$$x_1 = 26,304$$

$$x_2 = 27,668$$

$$x_3 = \frac{22 - .7113}{.0007333}$$

$$x_4 = \frac{23 - .7113}{.0007333}$$

$$x_3 = 29,031$$

$$x_4 = 30,395$$

$$x_5 = \frac{24 - .7113}{.0007333}$$

$$x_6 = \frac{25 - .7113}{.0007333}$$

$$x_5 = 31,759$$

$$x_6 = 33,122$$



## APPENDIX G

| STANDARD<br>MANPOWER TABLE            |       |                  | WORK CENTER TITLE/CODE<br>Base Stock Funds Accounting/1516 |       |       |       |       |       |
|---------------------------------------|-------|------------------|--|-------|-------|-------|-------|-------|
| AIR FORCE<br>SPECIALTY TITLE<br>(AFS) | AFSC  | MANHOUR<br>AVAIL | 25269* WORKLOAD VALUES                                     |       |       |       |       |       |
|                                       |       | 144              | 26304  | 27668 | 29031 | 30395 | 31759 | 33:22 |
|                                       |       |                  |  |       |       |       |       |       |
|                                       |       | GRADE            | MANPOWER REQUIREMENT                                       |       |       |       |       |       |
| Acct & Fin Off                        | 6724  | CIV              | 1  | 1     | 1     | 1     | 1     | 1     |
| Acct & Fin Supt                       | 67290 | CIV              | 2  | 2     | 2     | 2     | 2     | 2     |
| Acct & Fin Supvr                      | 67170 | CIV              | 3  | 3     | 3     | 3     | 3     | 3     |
| Gen Acct Spec                         | 67151 | CIV              | 12   | 13    | 14    | 15    | 16    | 17    |
| Gen Acct Spec                         | 67131 | CIV              | 1  | 1     | 1     | 1     | 1     | 1     |
| Admin Spec                            | 70250 | CIV              | 1  | 1     | 1     | 1     | 1     | 1     |
| Totals                                |       |                  | 20   | 21    | 22    | 23    | 24    | 25    |
| AIR FORCE<br>SPECIALTY TITLE<br>(AFS) | AFSC  | MANHOUR<br>AVAIL | WORKLOAD VALUES  |       |       |       |       |       |
|                                       |       | 144              | 34188*   |       |       |       |       |       |
|                                       |       |                  |  |       |       |       |       |       |
|                                       |       | GRADE            | MANPOWER REQUIREMENT                                       |       |       |       |       |       |
| Acct & Fin Off                        | 6724  | CIV              | 1  |       |       |       |       |       |
| Acct & Fin Supt                       | 67290 | CIV              | 2  |       |       |       |       |       |
| Acct & Fin Supvr                      | 67170 | CIV              | 3  |       |       |       |       |       |
| Gen Acct Spec                         | 67151 | CIV              | 18   |       |       |       |       |       |
| Gen Acct Spec                         | 67131 | CIV              | 1  |       |       |       |       |       |
| Admin Spec                            | 70250 | CIV              | 1  |       |       |       |       |       |
| Totals                                |       |                  | 26   |       |       |       |       |       |
| *Extrapolation Limits                 |       |                  |  |       |       |       |       |       |

## APPENDIX H

AFM 25-5

8 August 1973

A12-1

| PROGRAM MANAGEMENT REPORT   |          |               |         | APPLICATION DATE<br>FY 1/76   |               |            |
|---|----------|---------------|---------|---|---------------|------------|
| STUDY DESCRIPTION<br>Commercial Services & Materiel Sec Ofc, FC 1515/1516<br>Base & Tenant Services Acct      Base Stock Funds Acct<br>Systems & Receivables Acct<br>Internation Acct |          |               |         |   |               |            |
| 1. STUDY IMPACT (Manpower)  |          |               |         |   |               |            |
| GRADE   | FY 76    | FY 77         | FY 78   | NET CHANGE  | SALARY FACTOR | TOTAL      |
| GS11  | -1       | -1            | -1      | -3  | \$18,466      | -\$55,398  |
| GS06  | -2       | -2            | -2      | -6  | 11,301        | - 67,806   |
| GS05  | -3       | -3            | -3      | -9  | 10,138        | - 91,242   |
| NET IMPACT  | -6       | -6            | -5      | -18   |               | -\$214,446 |
| OTHER SAVINGS   |          |               |         |   |               |            |
| TOTAL STUDY IMPACT  |          |               |         |   |               | -\$214,446 |
| 2. COST OF STUDY (Personnel)  |          |               |         | 3. INDEX  |               |            |
| GRADE   | MAN DAYS | SALARY FACTOR | TOTAL   | INDEX = $\frac{\text{TOTAL STUDY IMPACT}}{\text{TOTAL STUDY COST}}$ |               |            |
| OLD RATES   |          |               |         |   |               |            |
| 0-1   | 20.25    | \$40.72       | \$ 825  |   |               |            |
| GS-09   | 72.00    | 46.80         | 3,370   |   |               |            |
| GS-05   | 28.75    | 40.24         | 1,157   |   |               |            |
|   |          |               | \$5,352 |   |               |            |
| NEW RATES   |          |               |         |   |               |            |
| 0-1   | 26.75    | \$41.52       | \$1,111 |   |               |            |
| GS-09   | 27.75    | 49.00         | 1,360   |   |               |            |
| GS-05   | 12.00    | 42.49         | 510     |   |               |            |
|   |          |               | \$2,981 |   |               |            |
| TEMPORARY DUTY COSTS  |          |               |         | REMARKS   |               |            |
| IMPROVEMENT STUDY COSTS   |          |               |         |   |               |            |
| TOTAL STUDY COSTS   |          |               | \$8,333 |   |               |            |

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PREVIOUS EDITION IS OBSOLETE.

APPENDIX I  
TASKS HYPOTHESIZED TO CHANGE

1. Answering telephone inquiries.
2. Producing administrative reports.
3. Filing reports of laboratory results in the laboratory files.
4. Preparing laboratory clinical forms (including logbooks, worksheets, etc.)
5. Compiling College of American Pathologist (CAP) standard workload figures.
6. Labeling specimens.
7. Preparing specimen collection lists.
8. Recording results of the tests that will be on-line after AFCLAS is introduced.
9. Recording results of the tests that will be off-line after AFCLAS is introduced.
10. Mark sense card entry of laboratory requests.
11. Keyboard entry of patient name and identification.
12. Mark sense card entry of laboratory test results.
13. Keyboard entry of laboratory test results.
14. Supervisor review and initialing of reports.
15. Performing mathematical analysis for quality control.
16. Calculations for test reports.
17. Operation of the computer by laboratory staff (does not include computer operation by personnel brought into the laboratory to perform this function).
18. Reporting results of "stat" tests by telephone.

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